



AUGUST 21-23, 2018 • CLEVELAND, OHIO

Improving Building Performance with Envelope Technologies

Thursday, August 23, 2018

4:00-5:30 pm



Improving Building Performance with Envelope Technologies

Moderator

- **Melissa Voss Lapsa**, Oak Ridge National Lab (ORNL)

Speakers

- **Simon Pallin**, ORNL
- **Stacy Lambright**, Hunter Douglas
- **Laverne Dalglish**, Air Barrier Association of America

Building Envelope: 5.81 Quads

The commercial building envelope is the primary determinant of the amount of energy required to heat, cool, and ventilate a building

Table 2. Primary Energy Consumption Attributable to Fenestration and Building Envelope Components in 2010 (Quads)⁶

Building Component	Residential		Commercial	
	Heating	Cooling	Heating	Cooling
Roofs	1.00	0.49	0.88	0.05
Walls	1.54	0.34	1.48	-0.03
Foundation	1.17	-0.22	0.79	-0.21
Infiltration	2.26	0.59	1.29	-0.15
Windows (Conduction)	2.06	0.03	1.60	-0.30
Windows (Solar Heat Gain)	-0.66	1.14	-0.97	1.38

Source: Office of Energy Efficiency and Renewable Energy 2011b; Office of Energy Efficiency and Renewable Energy 2011d; Office of Energy Efficiency and Renewable Energy 2011e; Office of Energy Efficiency and Renewable Energy 2011g

Barriers Identified for Envelope Technologies



- **Cost:** uncertainties, high first costs, ROI hurdles
- **Supply issues:** product fragility, availability, volume
- **Installation issues:** workforce training, complex systems, quality control
- **Decision culture:** resistance to new products, risk averse, code minimum culture
- **Information gap:** real world case studies, data on long-term performance, communicating effectively

Building Envelope Technology Research Team

Connecting Better Buildings partners with advanced building envelope technology solutions

- ✓ Technology verification studies
- ✓ Specification documents
- ✓ Case studies and fact sheets
- ✓ Calculators and analytic tools

Melissa Lapsa, M.B.A.



**Building Envelope
Technical Team Lead**

Simon Pallin, Ph.D.



**Building Envelope
Technical Lead**

Mahabir Bhandari, Ph.D.



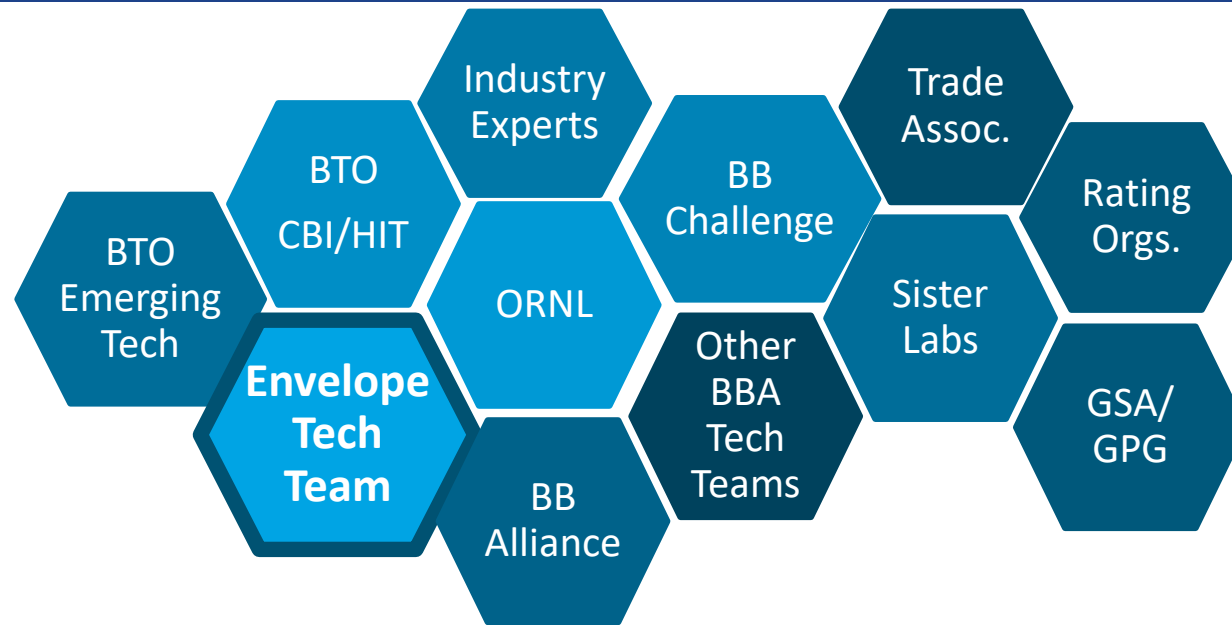
**Building Envelope
Tech Team Support**

Caroline Hazard, M.S.



**Building Envelope
Tech Team Support**

A Unique and Diverse Team



- Demonstration of high performance envelope technologies and solutions
- Comprised of Better Buildings Partners and representatives from the design community, including A&E firms

Join the Team!

Members

(includes: Building Owners/Mgrs, Property Managers, A&E, Construction/ Installers)

- [Adams 12](#)
- [Allegheny County Community College](#)
- [Arlington Initiative to Rethink Energy \(AIRE\)](#)
- [Brevard County School Board](#) ok
- [Clark Atlanta University](#) ok
- [Cook County Bureau of Asset Mgmt](#)
- [Emory University](#)
- [exp US Services, Inc.](#)
- [Green Dinosaur Inc.](#)
- [HOK](#)
- [Hersha Hospitality Mgmt](#)
- [Instituto Superior de Engenharia do Porto](#)
- [Legacy Health](#)
- [MA Dept of Energy Resources](#)
- More
- [Newmark Grubb Knight Frank](#)
- [Parkway Schools](#)
- [REI Co-op](#)
- [SABEY Data Centers](#)
- Schmidt
- [SIM²](#)
- [Smart Building Strategies LLC](#)
- [TN Office of Energy Programs](#)
- [Tishman Speyer](#)
- [Turner Construction Company](#)
- [US Army Corps of Engineers](#)
- z2zero

Join the Team!

Friends

(Includes: Researchers, Academics, Trade Associations, Energy Service Providers, Manufacturers, Subject Matter Experts)

- [Air Barrier Assoc of America](#)
- [American Institute of Architects](#)
- [AppleBlossom Energy, Inc.](#)
- [Argonne Nat'l Lab](#)
- [Association for Energy Affordability](#)
- [BA Consult](#)
- [BROAD U.S.A. Inc.](#)
- [Building Commissioning Assoc](#)
- [Building Envelope Materials \(BEM\)](#)
- [Covestro LLC](#)
- [Dow](#)
- [Dunsky Energy Consulting](#)
- [EIFS Industry Members Association](#)
- [Guardian Glass](#)
- [Humann Building Solutions](#)
- [ICF](#)
- [KUPU](#)
- [NanoPore](#)
- [National Fenestration Rating Council](#)
- [Northwest Energy Efficiency Alliance](#)
- [NRG Insulated Block](#)
- [Owens Corning](#)
- [QuadLock](#)
- [Renovate by Berkowitz](#)
- [Rmax Operating, LLC](#)
- [Sustainability Consultants LLC](#)
- [UNIFRAX](#)
- [USG Corporation](#)

What does the Envelope Team do?

Stakeholder Engagement

- **Recruit** Team members among BBA partners and representatives from the design community
- **Collaborate** to advancing investment in envelope technologies with team discussions, webinars, and participation in market studies

Build Awareness

- **Prime the market** by strengthening building owners/manager's understanding of envelope technologies
- Conduct envelope technology **demonstrations**
- Provide **guidance and tech assistance** for envelope projects

Document and Validate Results

- Prepare **site M&V plans** for technology demonstrations
- **Document results and produce case** studies and/or guidance for use in training, codes and/or standards

Technical Resources

- Online resources: **Windows, Walls, Roofs**
- Specifications, guidance, case studies, fact sheets, etc. **addressing market barriers** and assist advancement of envelope technologies

Current R&D Efforts

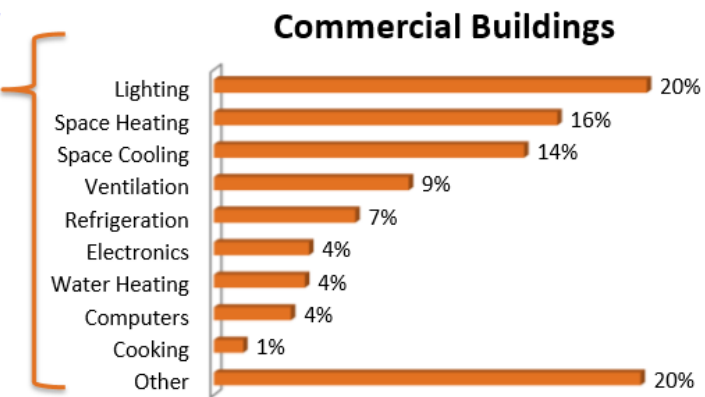
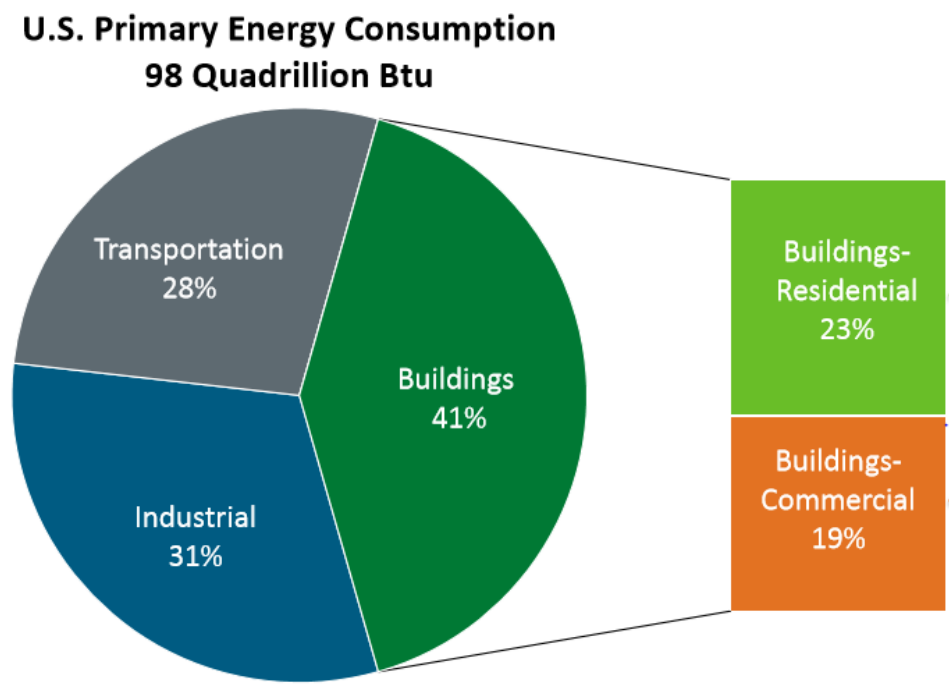
- Building Enclosure Commissioning
 - Benefits and Costs Study
 - Exploration of new enclosure performance metric
- Examination of Airtightness Requirements
 - Landscape Study
 - Sampling of air leakage rates



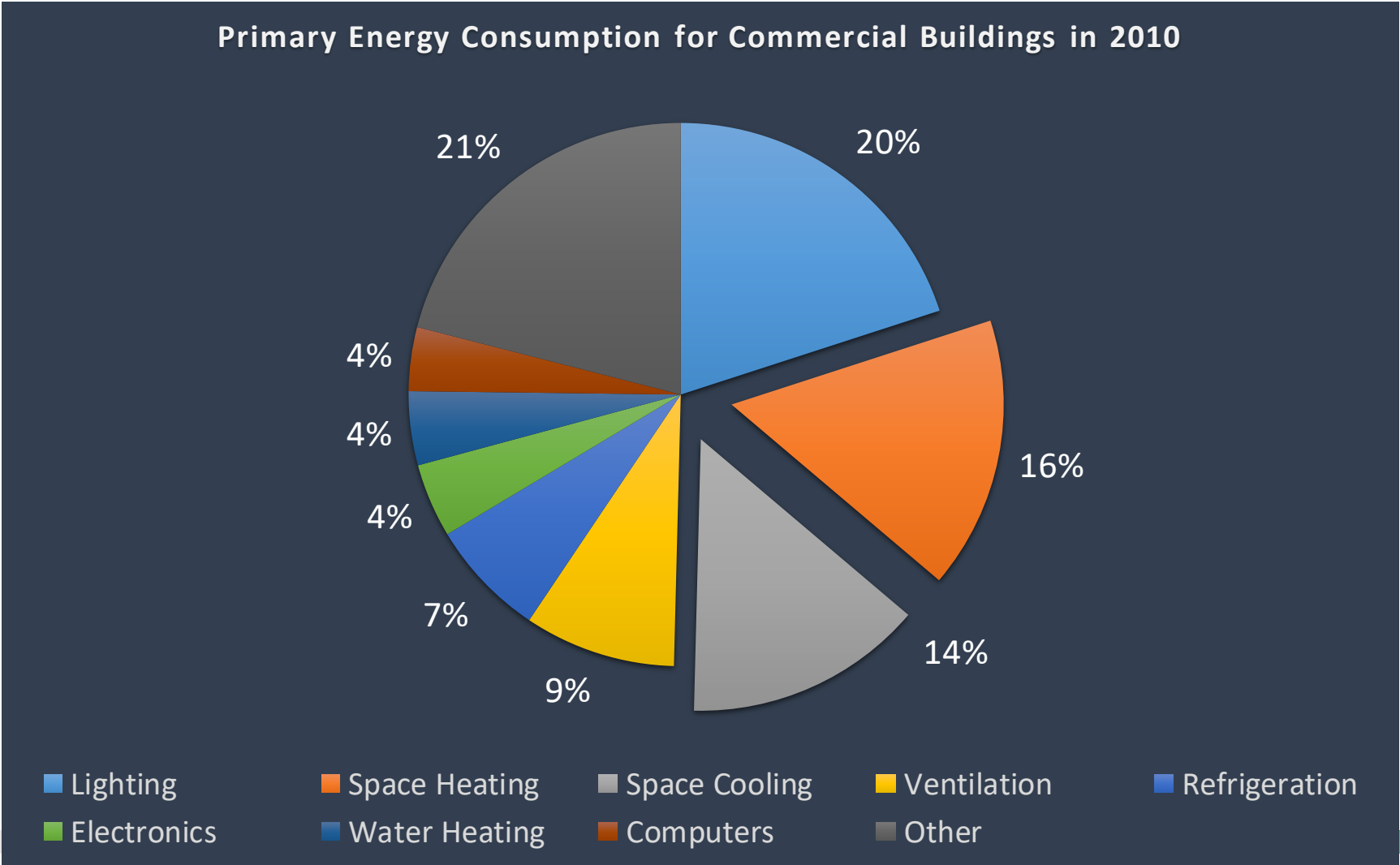
Simon Pallin

Oak Ridge National Lab (ORNL)

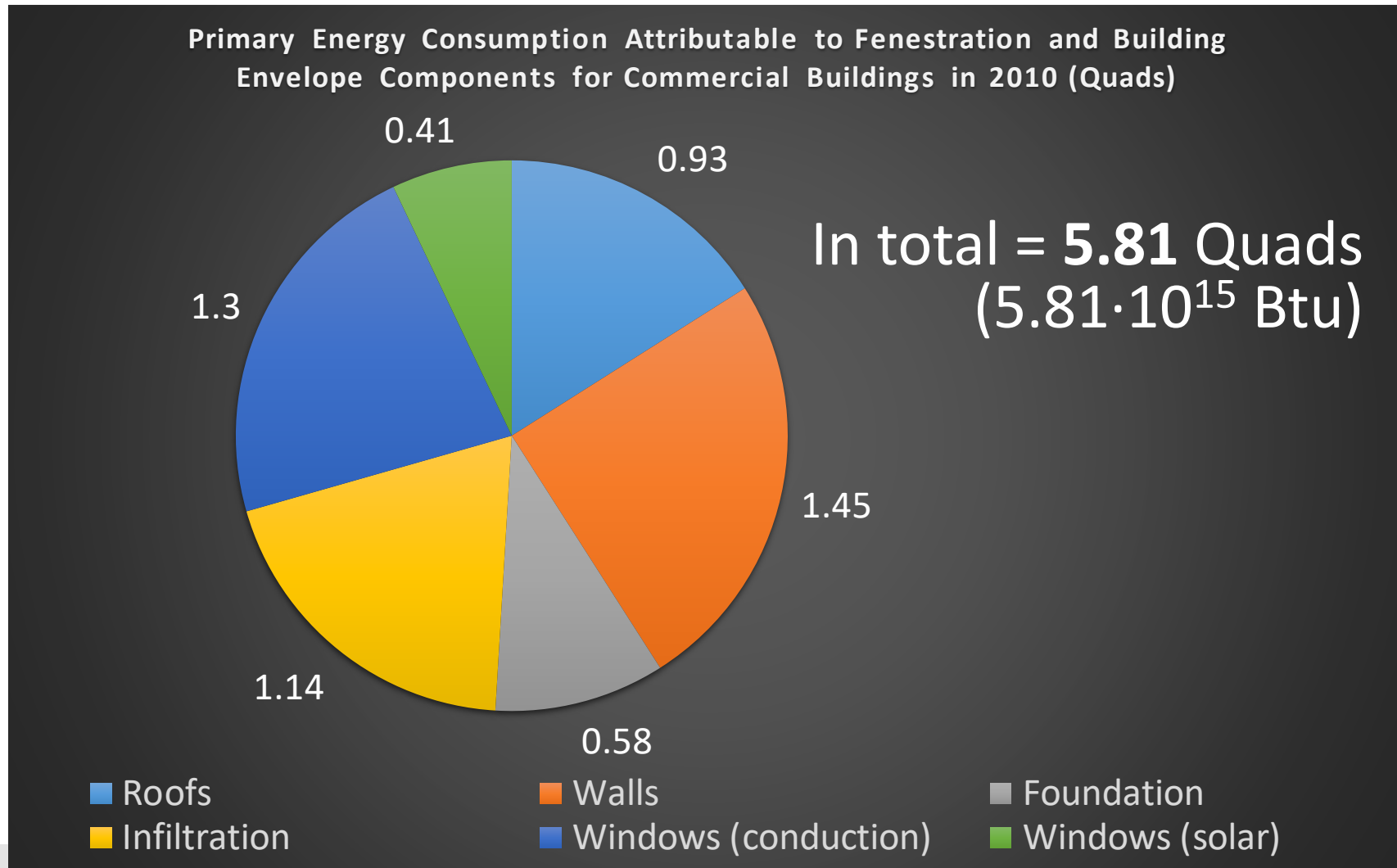
Building Envelope Market Potential



Building Envelope Market Potential



Building Envelope Market Potential



Building Envelope Market Potential

Primary Energy Consumption Attributable to Fenestration and Building Envelope Components for Commercial Buildings in 2010 (Quads)

0.41



209 million tons of coal



~ 1000 million barrels of oil

0.58

■ Roofs

■ Infiltration

■ Walls

■ Windows (conduction)

■ Foundation

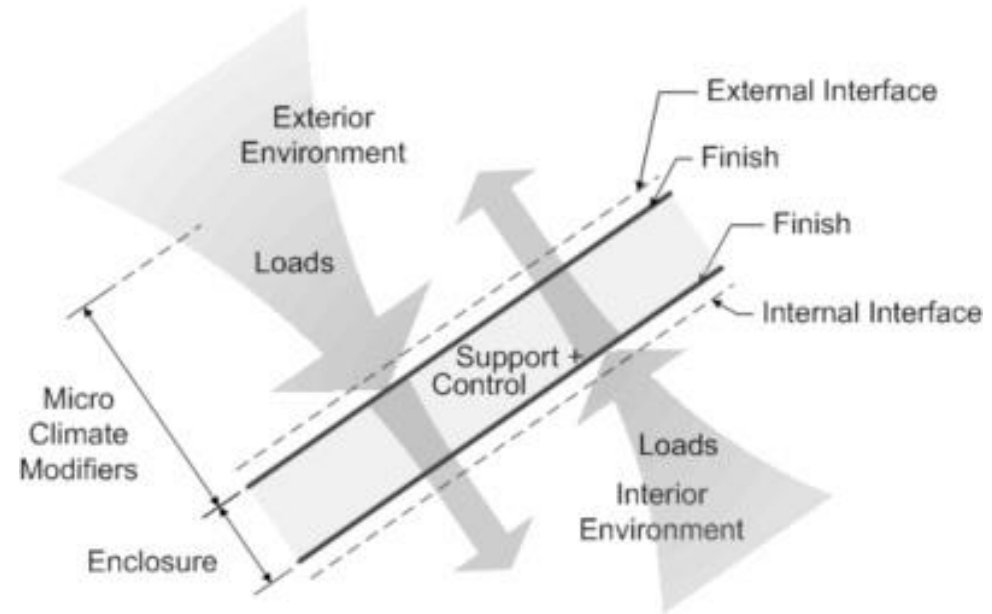
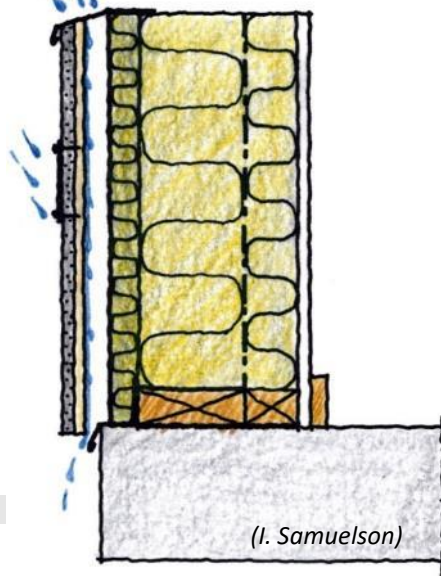
■ Windows (solar)

What is the Building Envelope?



What is the Building Envelope?

- Water Resistive Barrier
- Air Barrier
- Thermal Resistance
- Vapor Barrier
- Light
- Noise
- (Structural Performance)

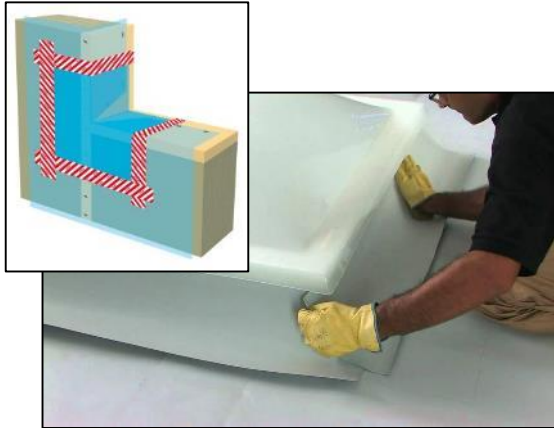


J. Straube

What is the Building Envelope?



Importance of Continuous Control Layers?



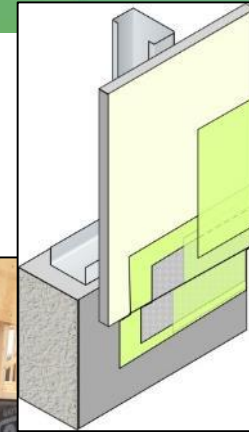
Window to Roof/Wall



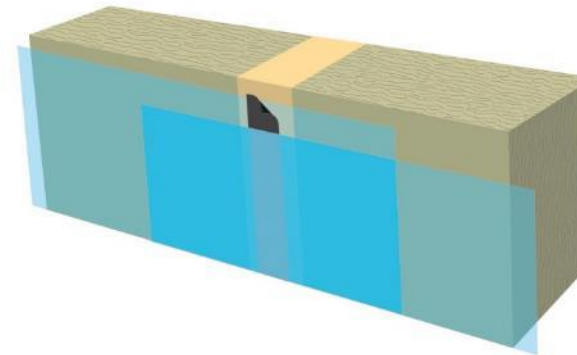
Wall to Roof



Wall to Slab

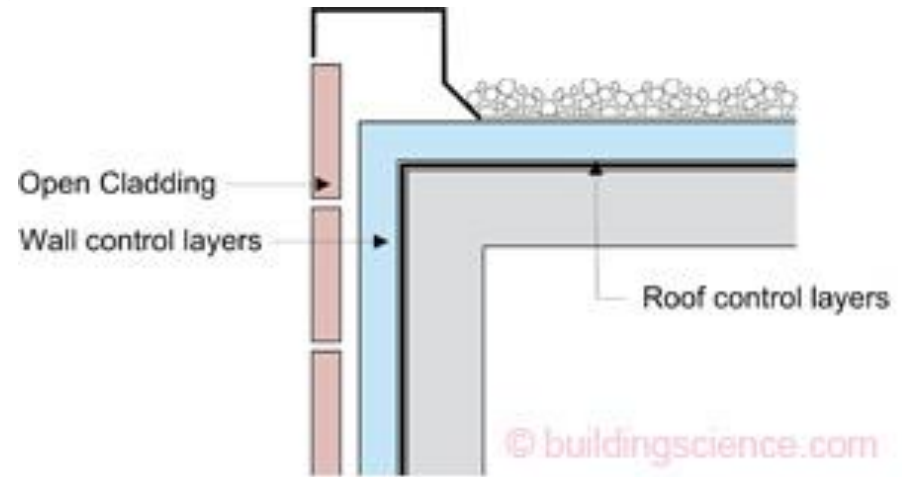
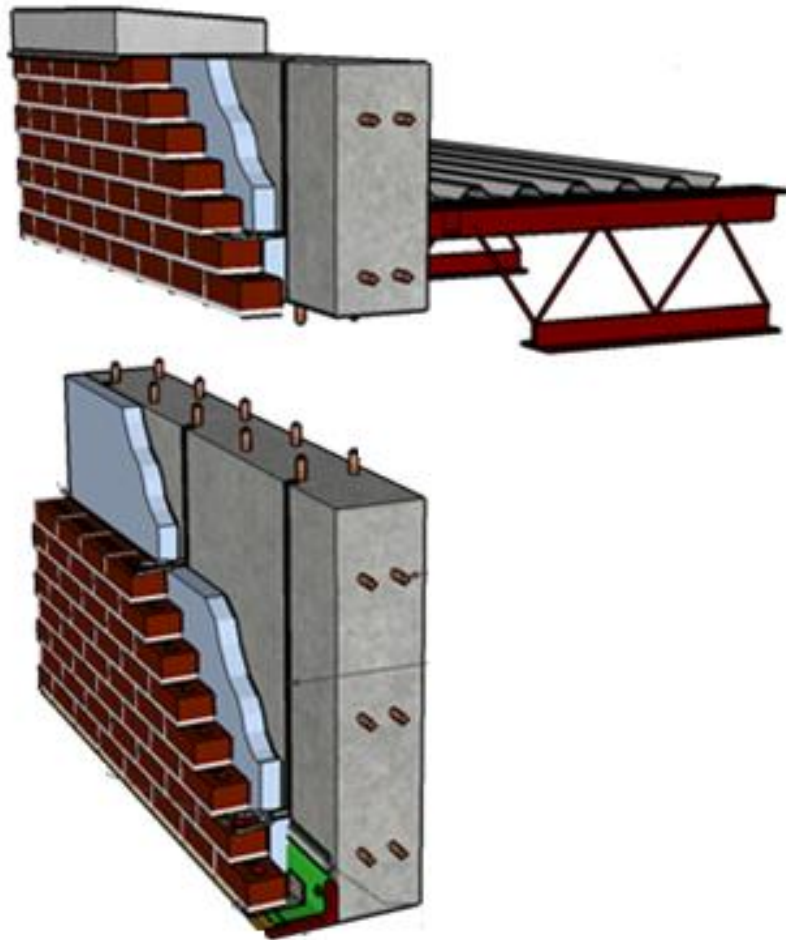


Penetrations



System Overlap

Importance of Continuous Control Layers?

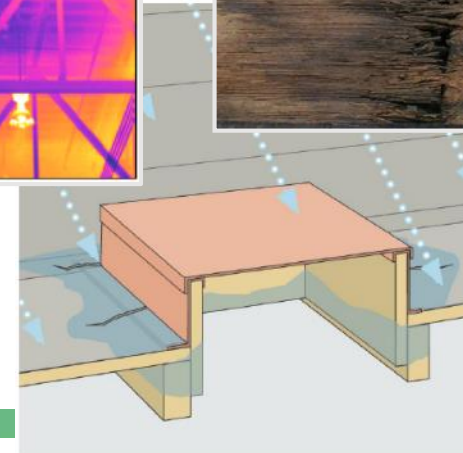
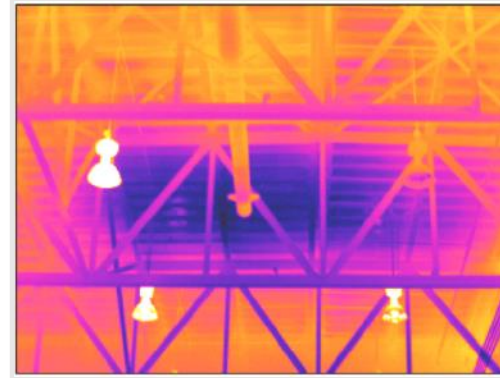
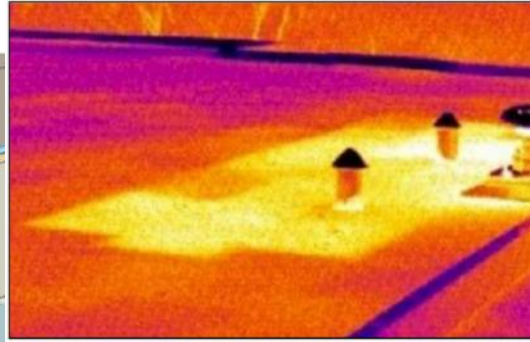
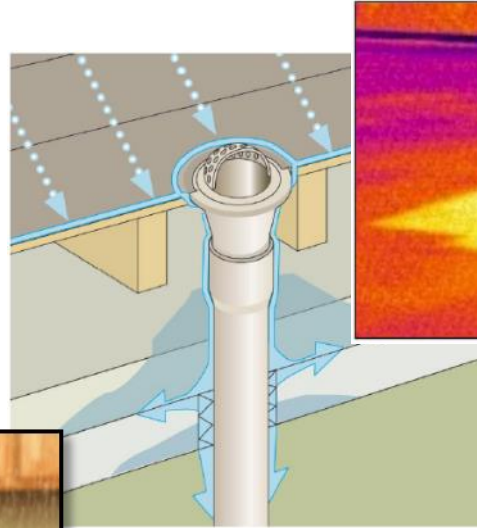


J. Lstiburek

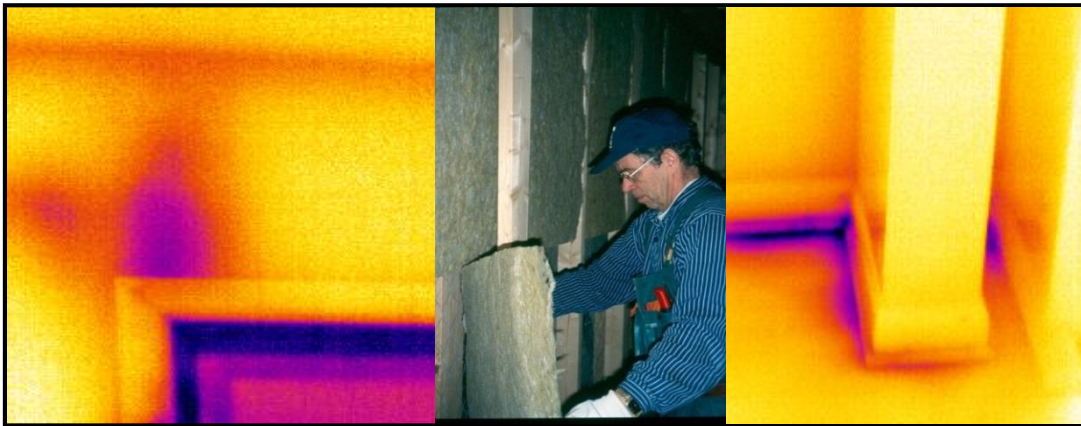
Importance of Continuous Control Layers?



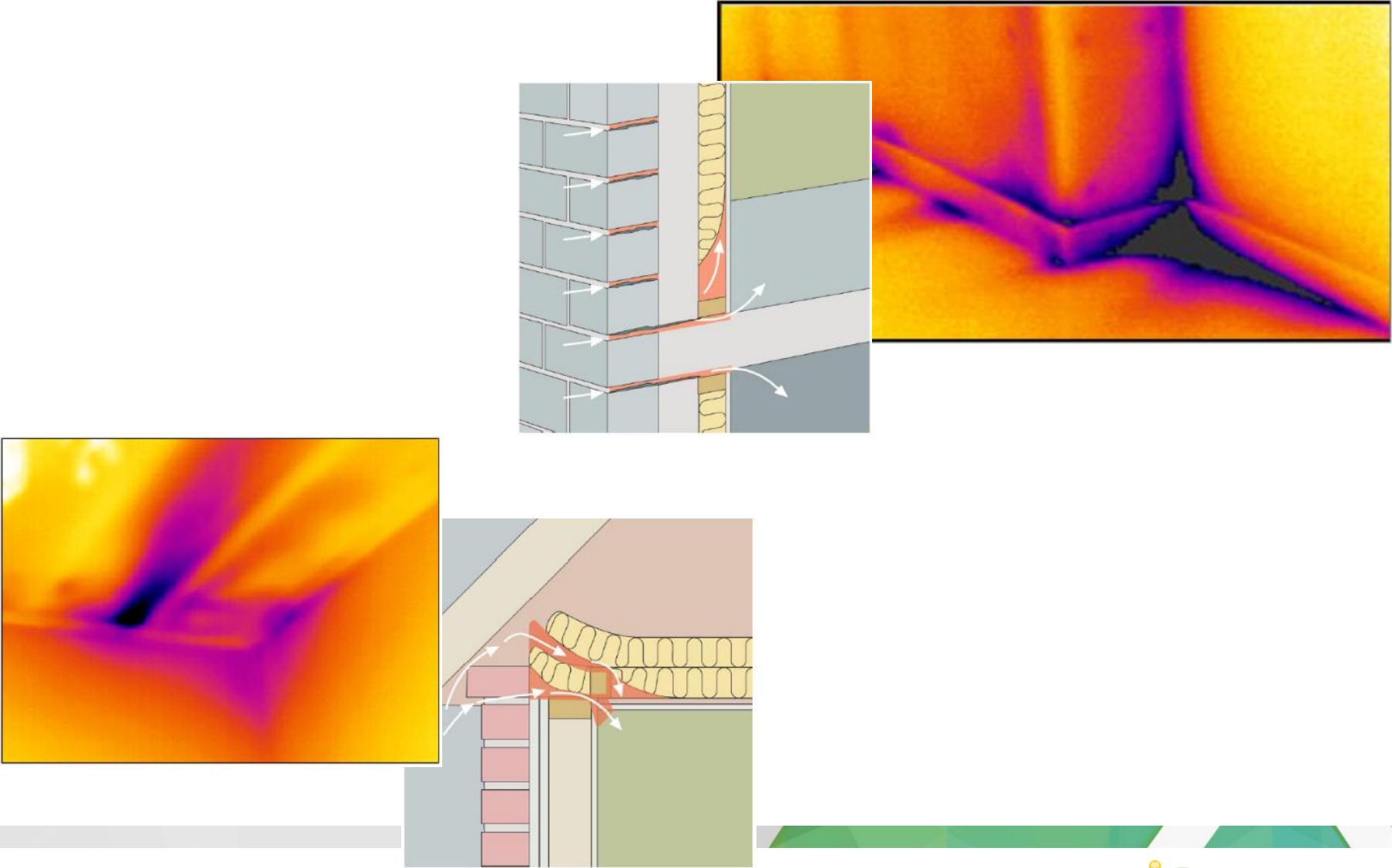
(accutechrestoration.com)



Constructed as Designed



Constructed as Designed



Constructed as Designed

Field Study - Airtightness of 12 Identical Buildings

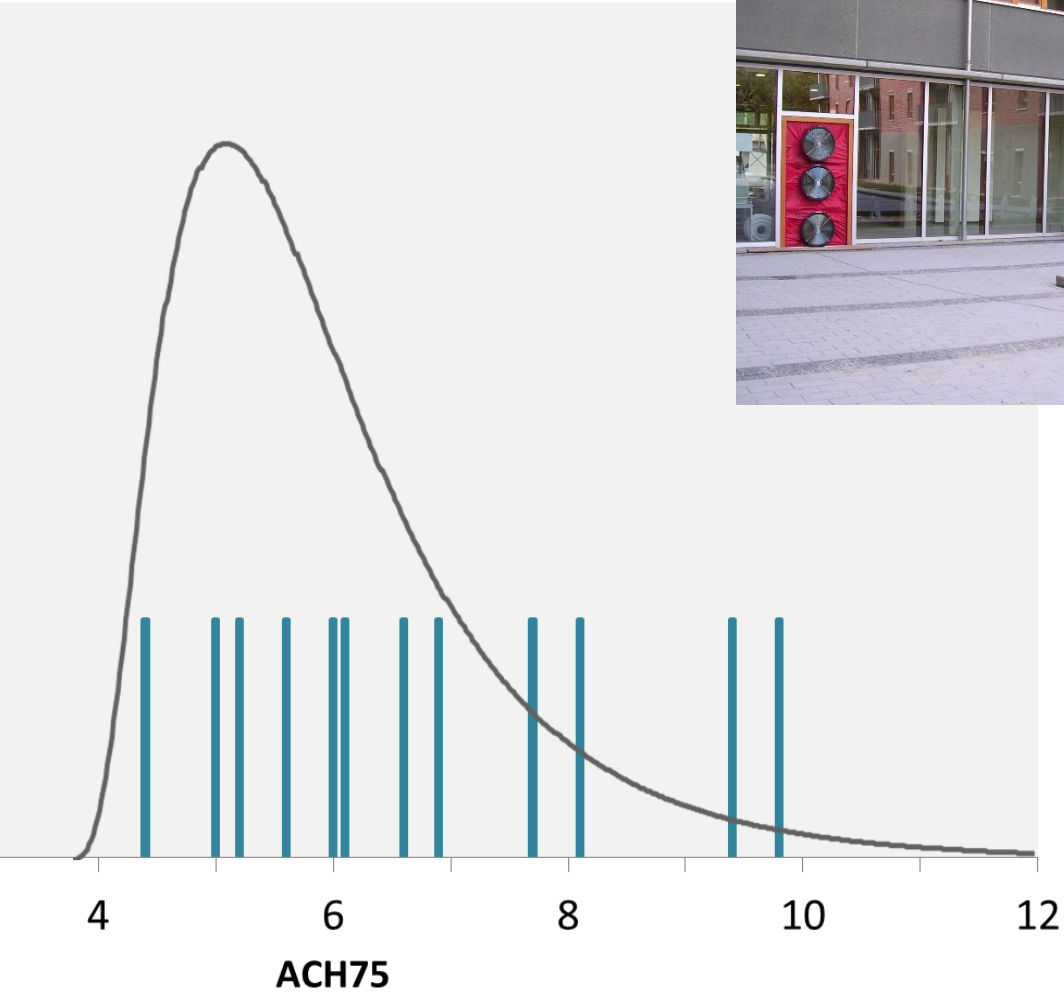
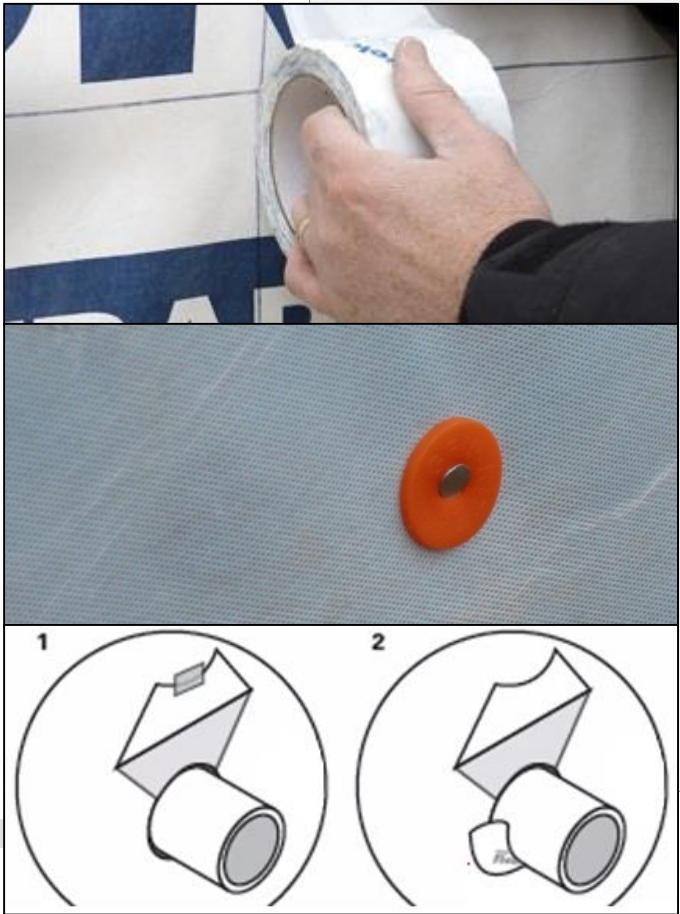
Factors that influence airtightness

- Construction design
- Floor area / Volume
- Penetration / Installations
- Material properties
- Workmanship

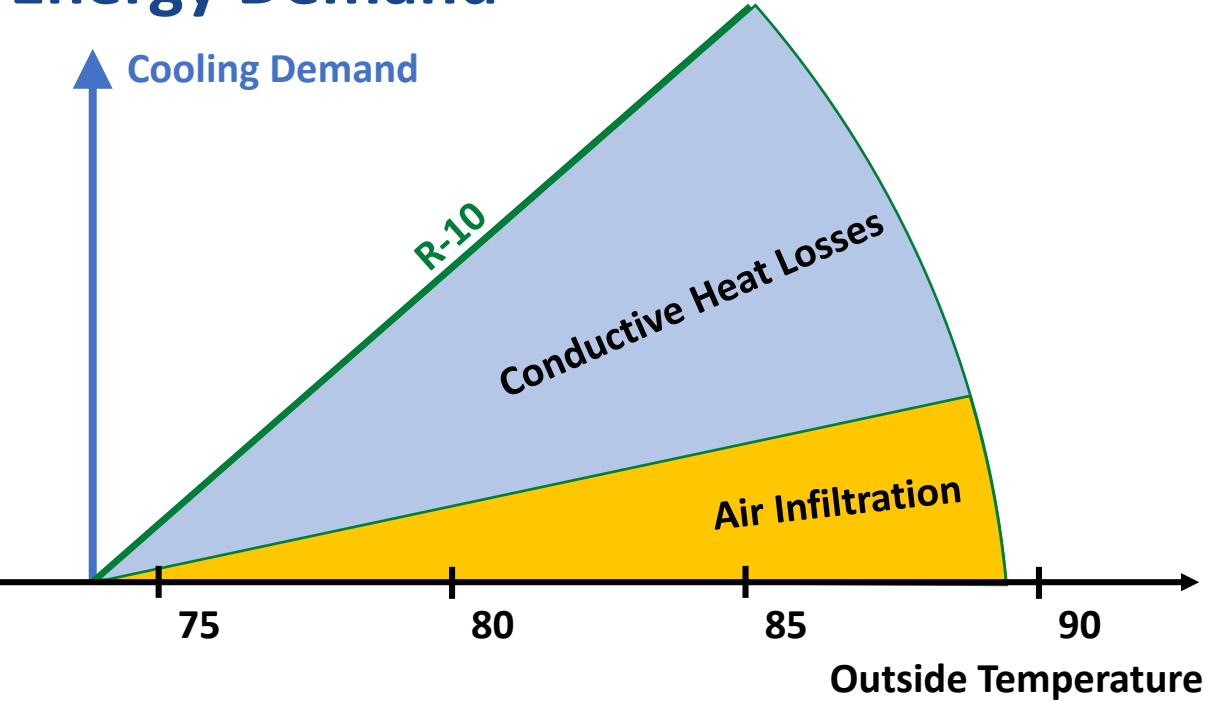
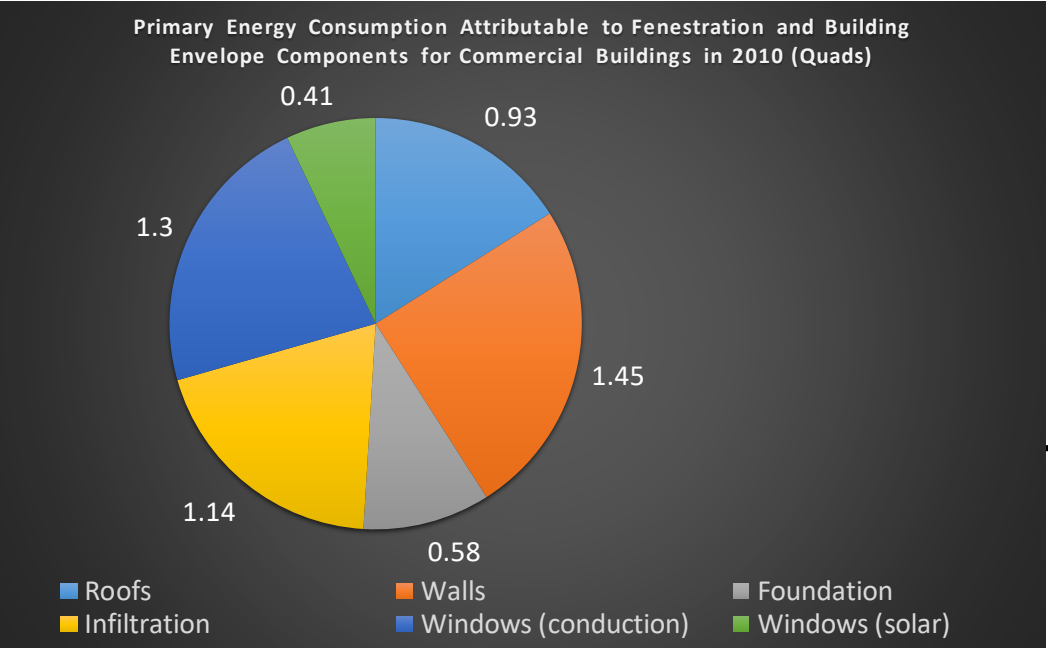


Constructed as Designed

Field Study - Airtightness of 12 Identical Buildings



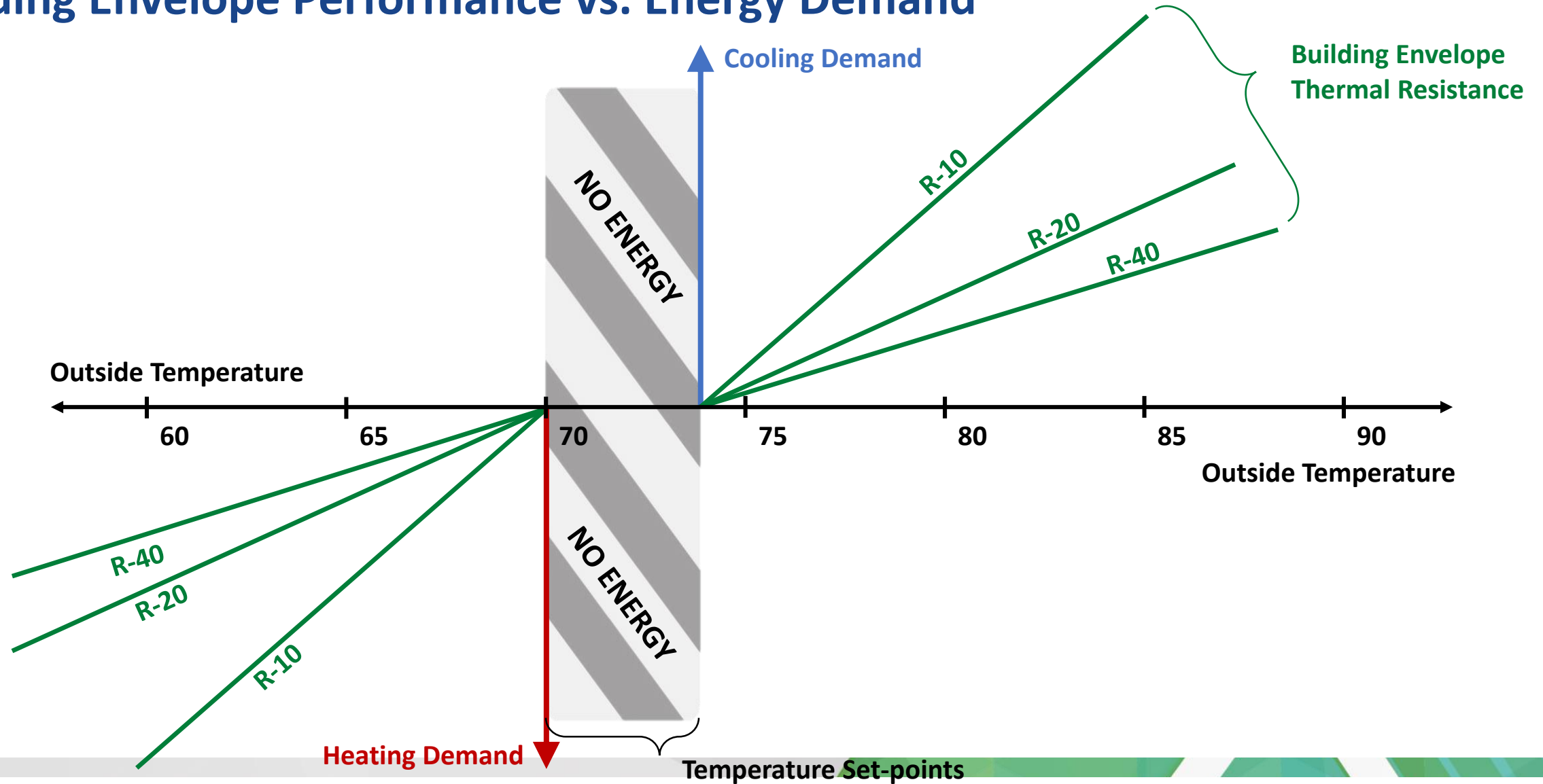
Building Envelope Performance vs. Energy Demand



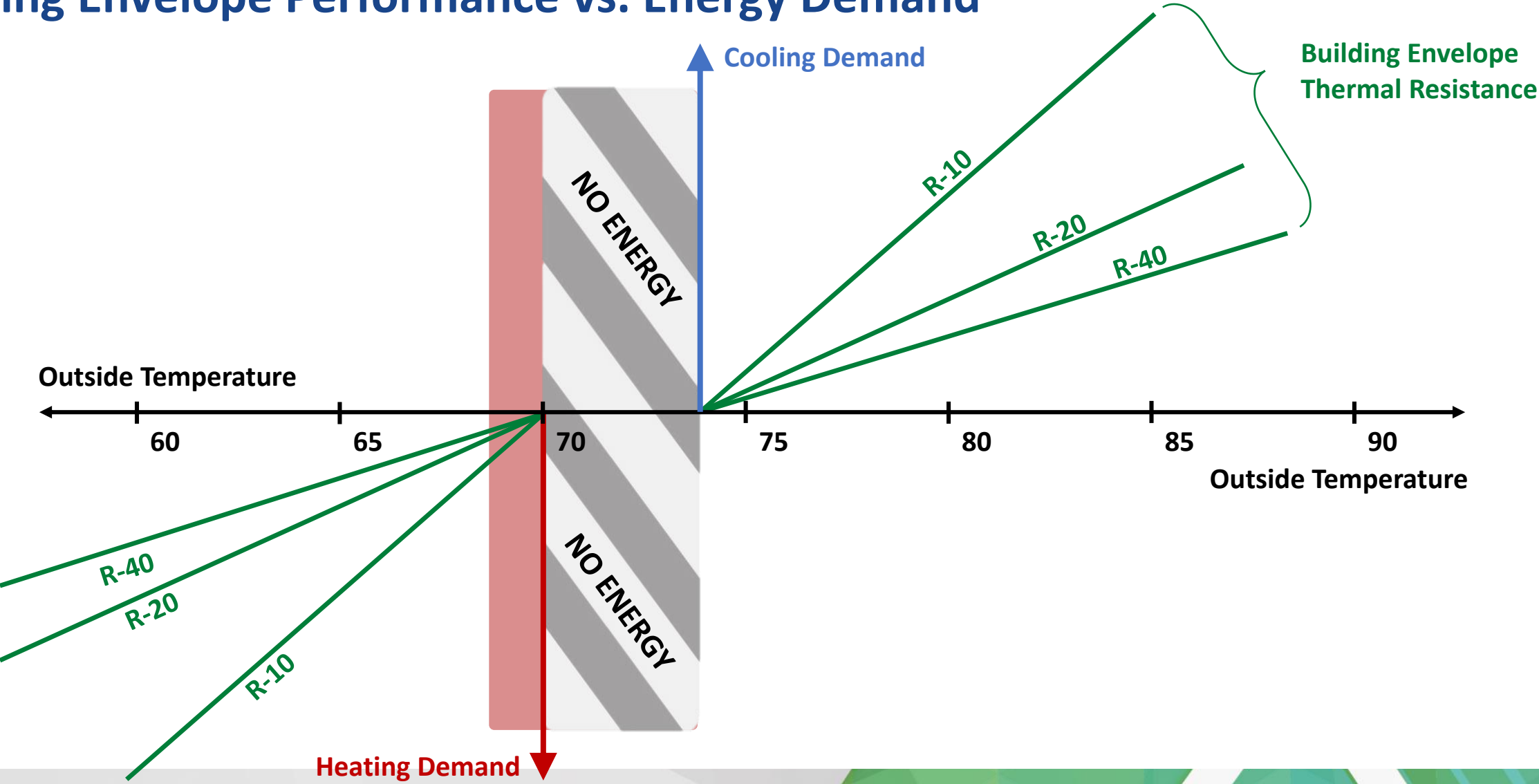
Heating Demand

Temperature Set-points

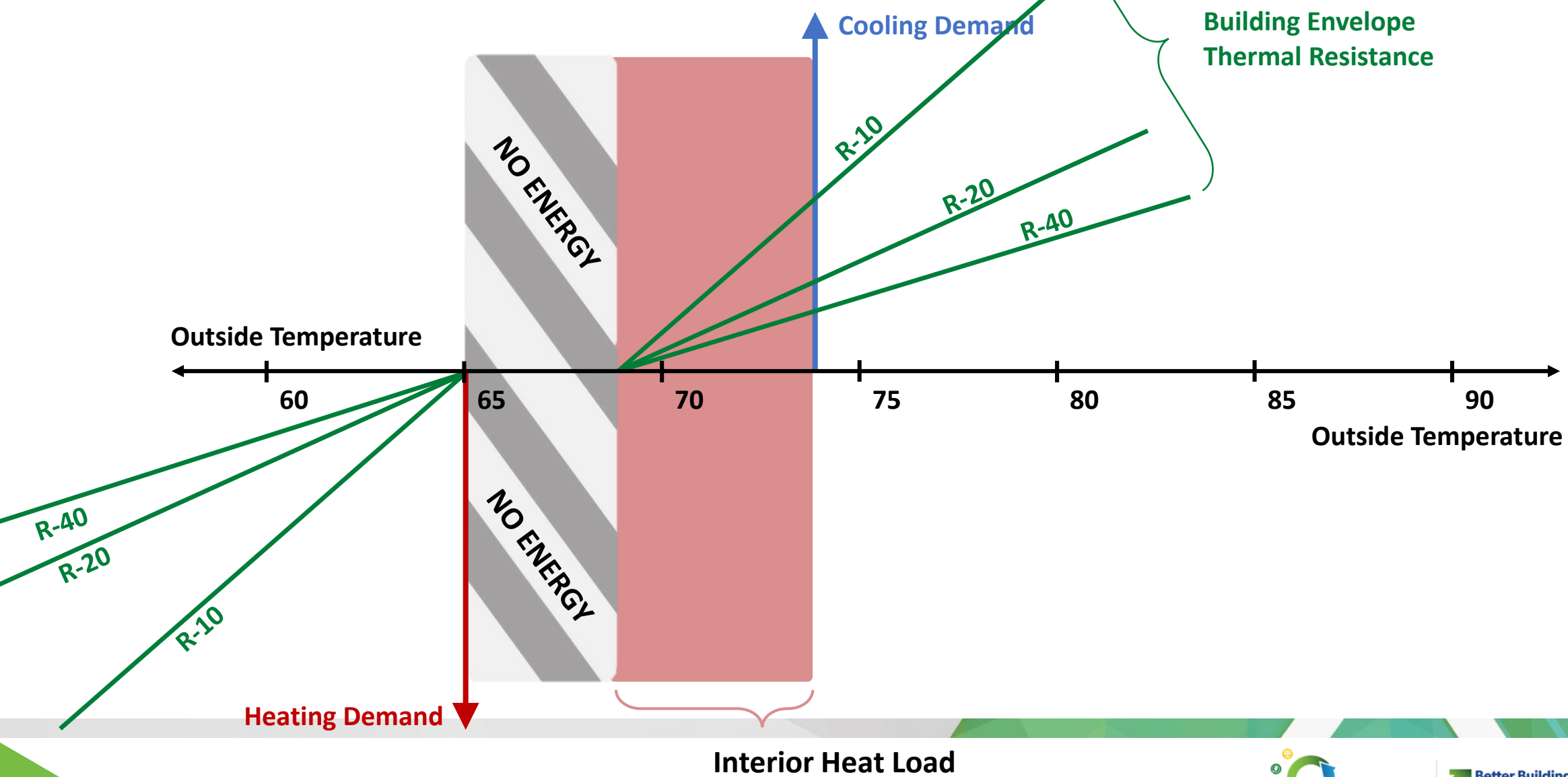
Building Envelope Performance vs. Energy Demand



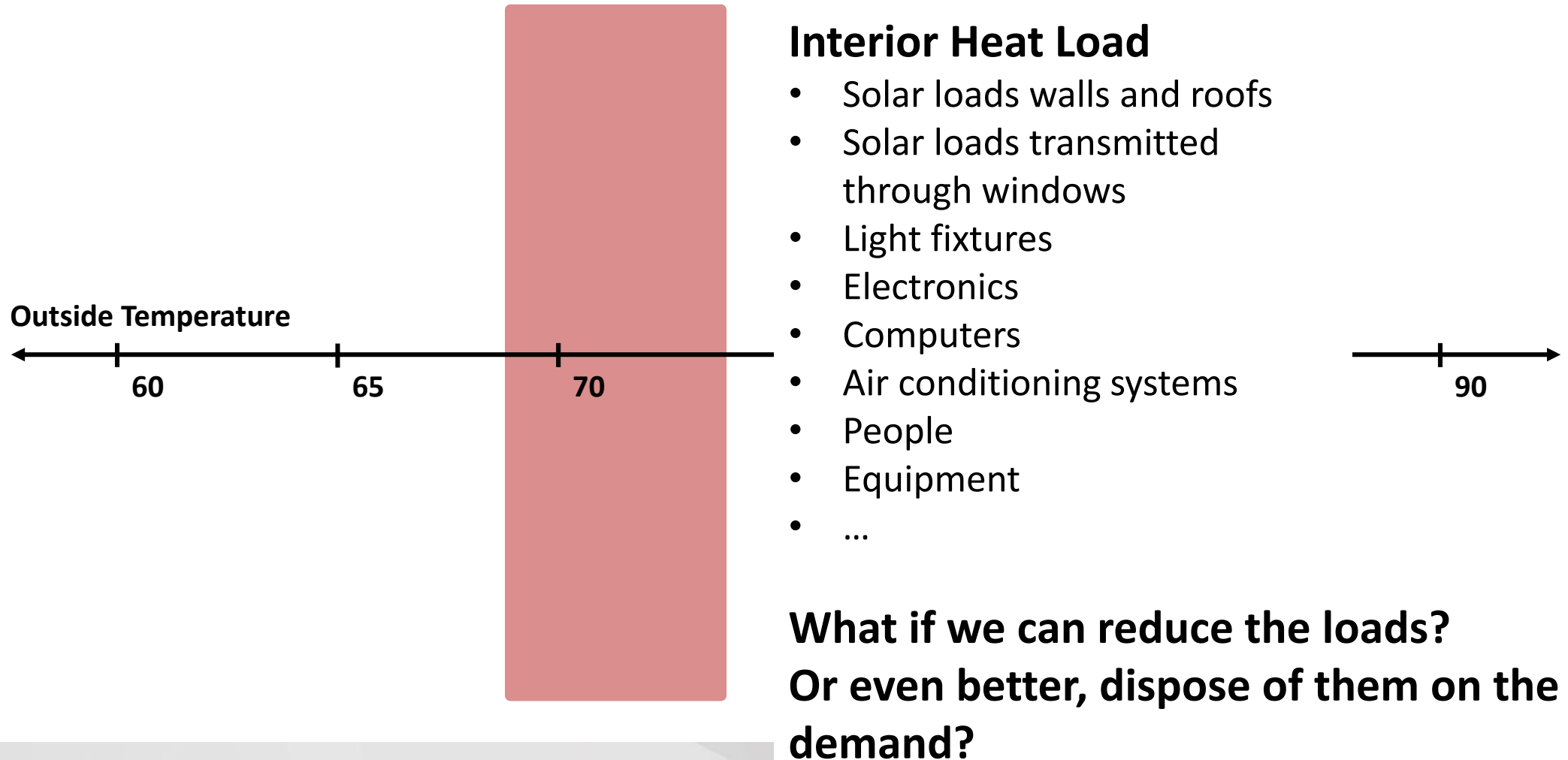
Building Envelope Performance vs. Energy Demand



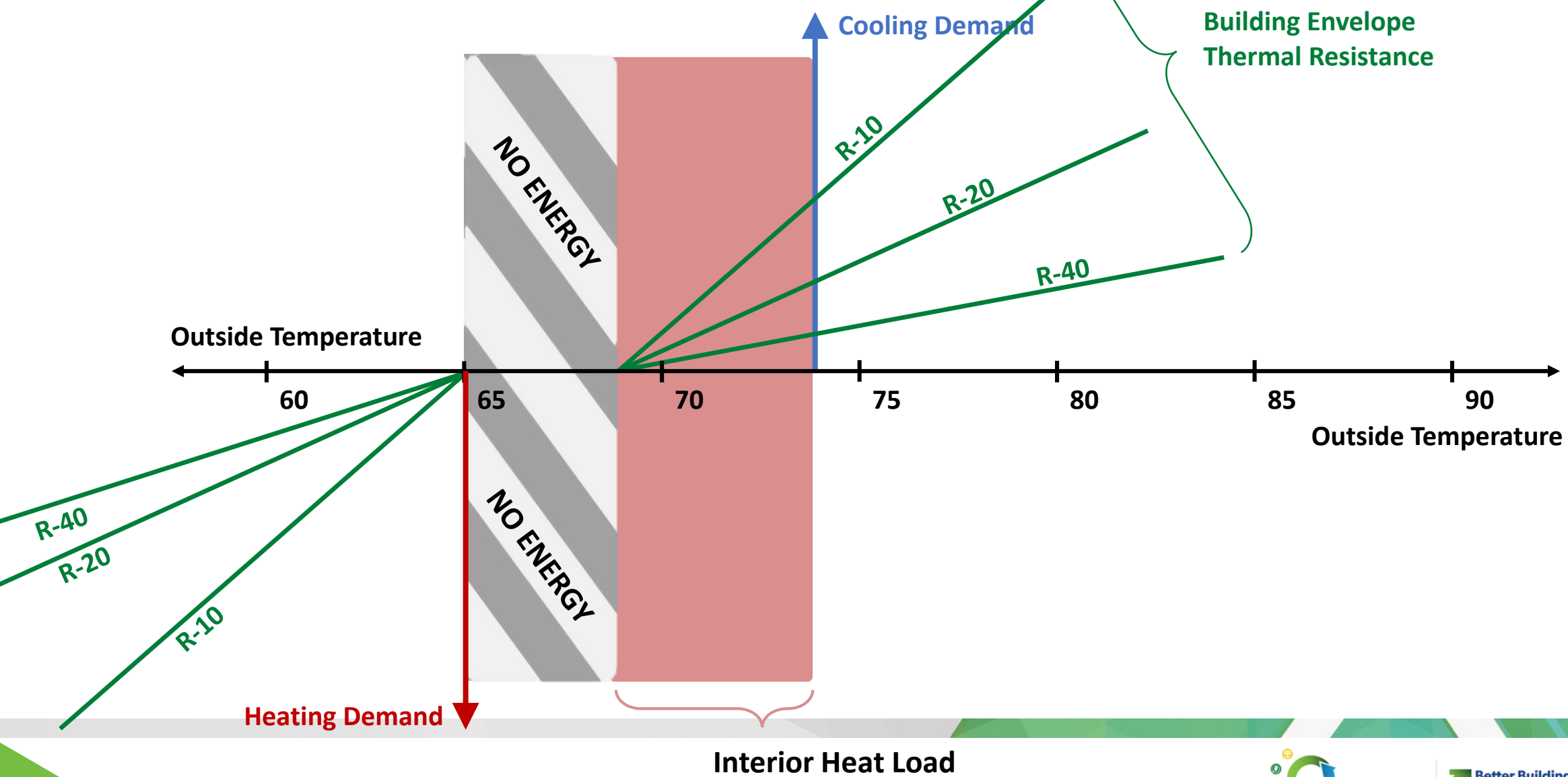
Building Envelope Performance vs. Energy Demand



Building Envelope Performance vs. Energy Demand



Building Envelope Performance vs. Energy Demand



Thank You

Simon Pallin, PhD
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Stacy Lambright

Hunter Douglas

Maximizing Building Performance with Window Attachments

2018 Energy Exchange & Better Buildings Summit

August 23, 2018

Stacy Lambright, Hunter Douglas

- Window attachments background
- Energy savings and other benefits of window attachments
 - Case studies
- AERC Overview
 - Commercial program development
 - Audience feedback

WINDOW ATTACHMENTS BACKGROUND

What are window attachments?

Interior Shutters



Blinds



Cellular Shades



Roller Shades



What are window attachments?

Storm Windows/ Secondary Glazing Systems



Exterior Roller Shutters



Awnings



Exterior Roller Shades



What are window attachments?

Location	Interior or exterior
Operation	Manual, motorized, or automated
Design scenarios	New construction or retrofit
Residential & Commercial	<ul style="list-style-type: none">• Detached single-family and multi-family residential• Small commercial buildings, large apartment buildings, dormitories, nursing homes, assisted living facilities• Federally owned buildings (military housing, barracks, dormitories, and Veterans Administrations cares facilities)• Historic buildings• Large commercial and industrial buildings

ENERGY SAVINGS



Windows make up 34% of a commercial building's heating and cooling energy

How many of you are currently using window attachments to address energy savings and occupant comfort?



How can window attachments save energy?

- Attachments can help manage solar heat gain, air leakage, daylight, and glare
- Can reduce energy use from:
 - HVAC
 - Lighting



- Improved occupant experience and productivity
 - Thermal **comfort**
 - **Daylight** access
 - Glare reduction
 - Maintain **views**



Hinesburg, VT Case Study¹

NRG Systems (wind turbine systems company)

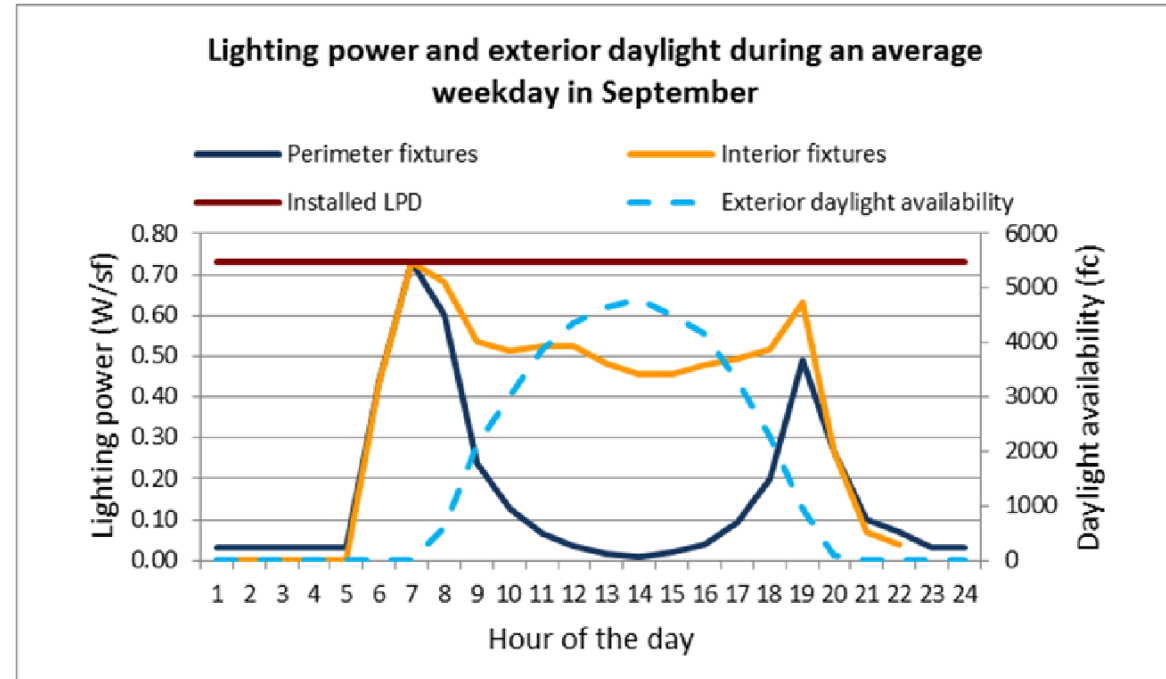
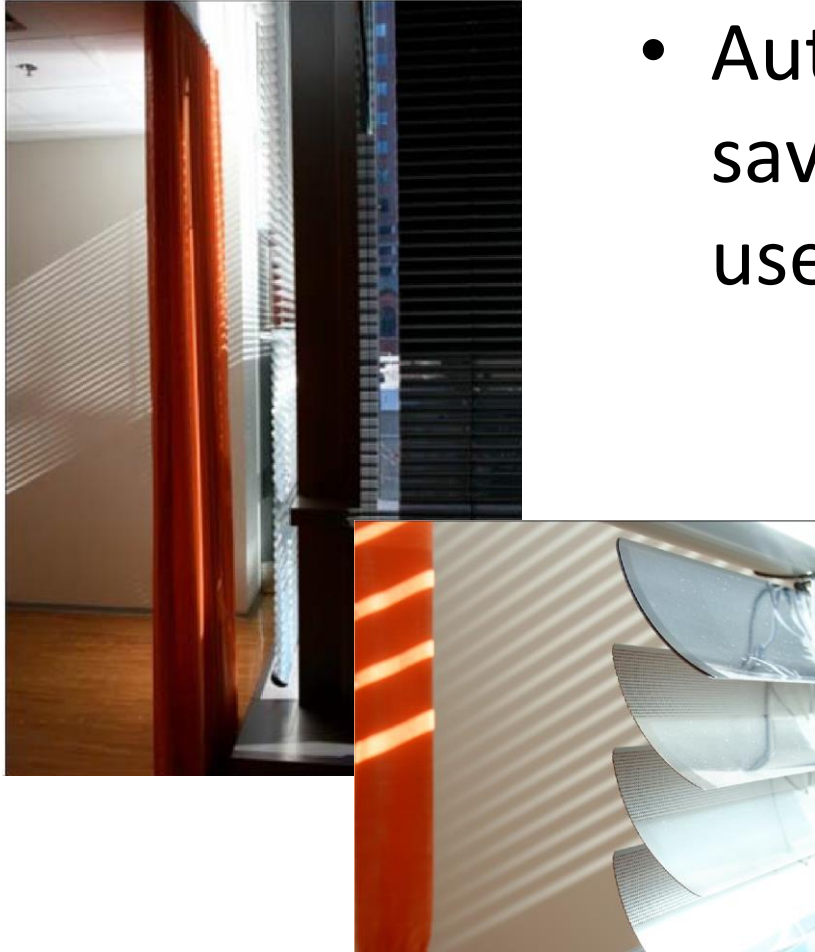


- Manually operated horizontal blinds combined with reflective ceiling and wall designs and photocontrols to adjust lighting
- **20 – 30%** savings on electric lighting energy use
 - Higher savings if blinds were automated

Cambridge, MA Case Study²

Genzyme (biotechnology company)

- Automated daylight-redirecting blinds help save over **45%** of electric lighting energy use



New York City Case Study³

1 floor in LEED Gold large office building

- Automated interior roller shades and LED lighting
- 79% energy savings
 - **14% attributable to optimized automated shades**



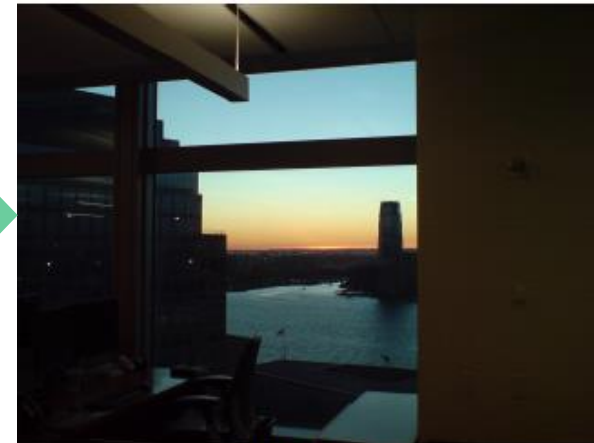
3:09 PM DST



6:09 PM DST

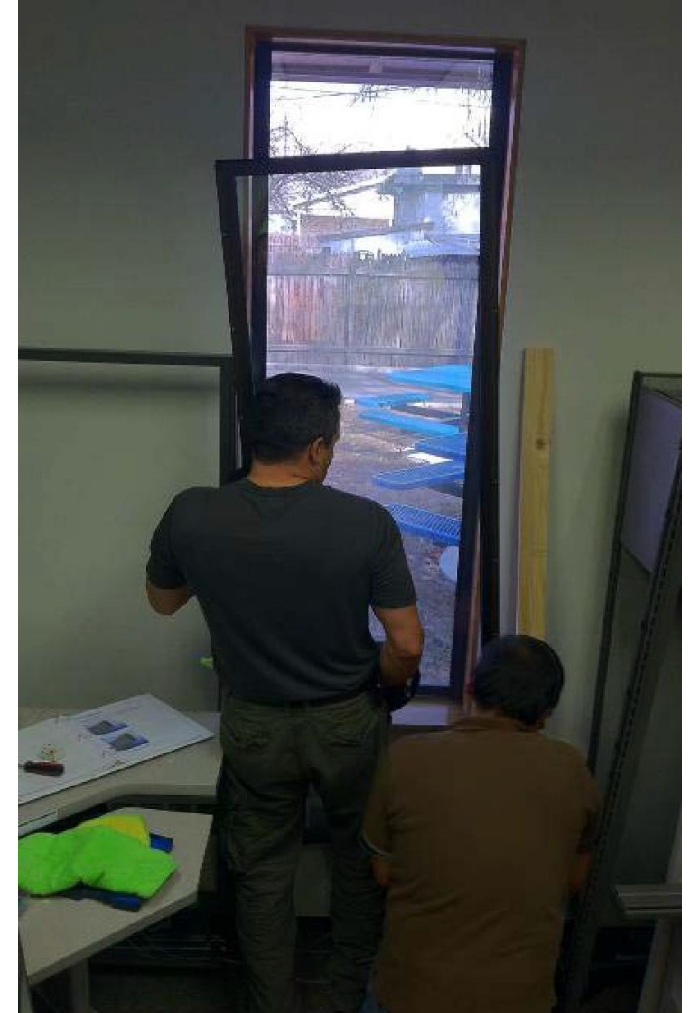


6:39 PM DST



7:09 PM DST

- Highly insulating storm window retrofit
 - Additional 3 glazing layers
- **34 – 41%** building heating load reduction during winter months
 - Estimated 9-year payback
- Occupants reported **improved thermal comfort** – reduced or eliminated use of personal portable space heaters



California Office Case Study⁵

Sacramento Municipal Utility District Call Center and Office

- Access to quality views, reduced glare, improved ventilation, and daylight showed improvements in:
 - **Worker productivity and focus**
 - **Physical and mental health**



Value to Building Owners and Managers



- Energy savings
 - Decreased HVAC and lighting load
- Improved occupant satisfaction
 - Fewer complaints
 - Better occupancy and retention
- Automated attachments
 - Synergy across building systems (HVAC, lighting, attachments)
 - Self-managing

AERC OVERVIEW

Attachments Energy Rating Council (AERC)

AERC is an independent, **public interest** organization whose mission is to provide consumers with **credible, relevant, and comparable** information about **window attachments** and their **performance**.



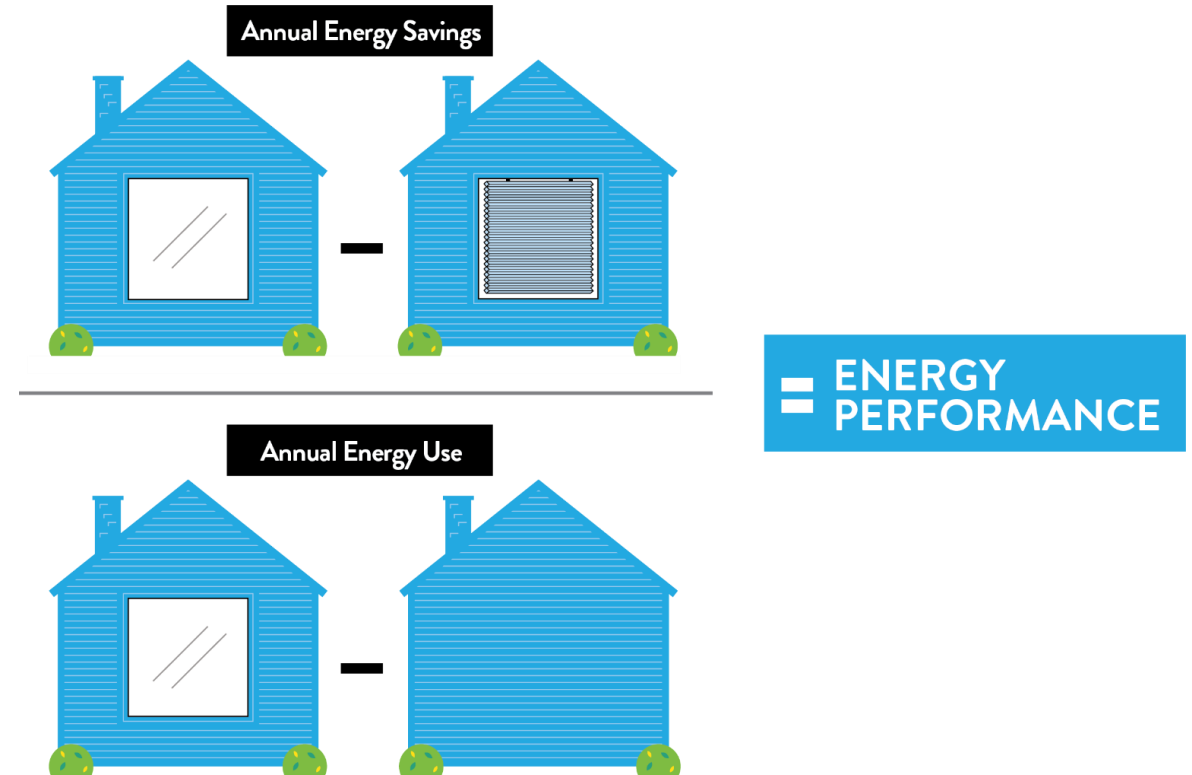
AERC members include:

- Public Interest Groups
- National Labs
- Commercial Labs
- Product Manufacturers
- Component Manufacturers
- Utilities


- Window attachments can save energy
 - Many consumers are unaware of their energy-saving capability
- Consumers have no way to compare the energy performance of attachments
- Energy Efficiency program managers also benefit from ratings and energy performance information

Residential Certification Program

- Launched in March 2018
- Products rated for:
 - U-factor
 - Solar Heat Gain Coefficient
 - Visual Transmittance
 - Air Leakage (as applicable)
 - Annual Energy Performance
 - Cold climate (Minneapolis)
 - Warm climate (Houston)



Residential Product Label and Website




PRODUCT SEARCH ENERGY RATING LABEL WINDOW ATTACHMENTS GUIDE RESOURCES ABOUT US

Look for the Label

Your resource for energy efficient window products

LOOK FOR THE ENERGY IMPROVEMENT LABEL



Energy Rated. Added Comfort.

Did you know that window attachments – such as blinds, shades and shutters – can help you save only that, energy efficient window attachments make it easier for you to control the temperature and added comfort.

Save energy and make your home more comfortable.

Window attachments products with this label—such as **blinds, shades, shutters and storm windows**—can help you do both.

- ### 1. Look for the AERC Energy Improvement Label

Seeing the AERC Energy Improvement label on a window attachment product means it will help you save energy and make your home more comfortable. This label also allows you compare energy improvement across different product types in order to select the best one for your home.
- ### 2. Choose Your Climate

Since window attachments can help keep your home warmer in cool climates and cooler in warm climates, this label helps you select the best product for where you live.

Cool Climate

If you tend to turn on the heat more throughout the year, be sure to look at the **COOL CLIMATE RATING**.

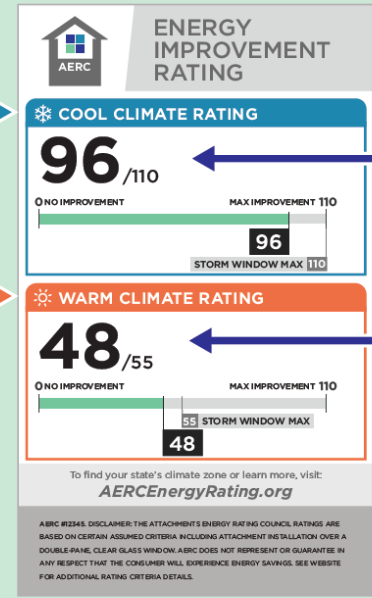
Warm Climate

If you tend to use your air conditioning more throughout the year, then take a look at the **WARM CLIMATE RATING**.
- ### 3. Discover Your Energy Savings

The amount of energy you can save will vary based on the type of product you buy.

96_{/110}

The large number indicates the product's **energy rating**. The smaller number indicates the **maximum energy rating** possible for that product category (storm windows, in this case). So, the closer the product's energy rating is to the maximum energy rating in your climate, the greater your energy savings!



ENERGY IMPROVEMENT RATING

COOL CLIMATE RATING

96_{/110}

0 NO IMPROVEMENT MAX IMPROVEMENT 110

96 STORM WINDOW MAX 110

WARM CLIMATE RATING

48_{/55}

0 NO IMPROVEMENT MAX IMPROVEMENT 110

55 STORM WINDOW MAX 48

To find your state's climate zone or learn more, visit:
AERCEnergyRating.org

AERC #12345. DISCLAIMER: THE ATTACHMENT'S ENERGY RATING COUNCIL RATINGS ARE BASED ON CERTAIN ASSUMED CRITERIA INCLUDING ATTACHMENT INSTALLATION OVER A DOUBLE-PANE, CLEAR GLASS WINDOW. AERC DOES NOT REPRESENT OR GUARANTEE IN ANY RESPECT THAT THE CONSUMER WILL EXPERIENCE ENERGY SAVINGS. SEE WEBSITE FOR ADDITIONAL RATING CRITERIA DETAILS.

In some cases, you may see "Not applicable for energy savings" listed instead of a rating number. This means that the product is not recommended for energy improvement in that particular climate.

ENERGY RATED. ADDED COMFORT.

Want to learn more? Visit www.AERCEnergyRating.org

Commercial Program Development

- AERC developing commercial certification program
- Identifying stakeholder needs (different from residential)
 - Product ratings
 - Energy performance (0-100)
 - Thermal comfort
 - Glare
 - Daylight
 - Energy modeling best practices for project-specific performance
 - Product selection guidance
 - Level of detail

- How do you currently make decisions about window attachments?
 - What information would make that process easier?
- What benefits have you had related to windows and attachments?
- Any other comments or suggestions for AERC?



THANK YOU!

HunterDouglas 

Stacy Lambright
Energy Efficiency Product Manager
Hunter Douglas
stacy.lambright@hunterdouglas.com

info@aecrcnet.org

1. Heschong Mahone Group (2011). NYSERDA Daylighting Case Studies: NRG Systems, Hinesburg, VT. *New York State Energy Research & Development Authority report*.
<https://www.trcsolutions.com/writable/images/NYSERDA-Daylighting-NRG-Case-Study.pdf>
2. Heschong Mahone Group (2011). NYSERDA Daylighting Case Studies: Genzyme, Cambridge, MA. *New York State Energy Research & Development Authority report*.
<https://www.trcsolutions.com/writable/images/NYSERDA-Daylighting-Genzyme-Case-Study.pdf>
3. Lee, E. S., et al. (2017). Demonstration of Energy Efficient Retrofits for Lighting and Daylighting in New York City Office Buildings. *Ernest Orlando Lawrence Berkeley National Laboratory report*.
<https://windows.lbl.gov/publications/demonstration-energy-efficient-retrofits-lighting-and-daylighting-new-york-city-office>
4. Curcija, C., Goudey, H., Mitchell, R. & Dickerhoff, E. (2013). Highly Insulating Window Panel Attachment Retrofit. *Ernest Orlando Lawrence Berkeley National Laboratory report*.
https://www.gsa.gov/cdnstatic/HiR_Panel_FullReport_6-13-13_508.pdf
5. Heschong Mahone Group (2003). Windows and Offices: A Study of Office Worker Performance and the Indoor Environment. *California Energy Commission report*.
<https://www.trcsolutions.com/writable/images/CEC-Windows-Offices-Report.pdf>

Laverne Dalglish

Air Barrier Association of America

Better Buildings Summit

air barrier
abaa
association of
america

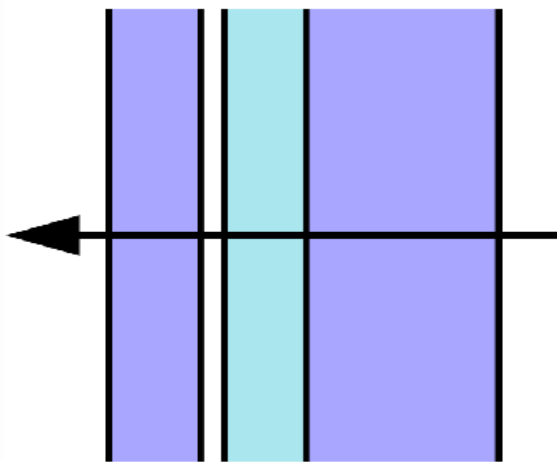
Air Barrier Technologies

Where does air leak?

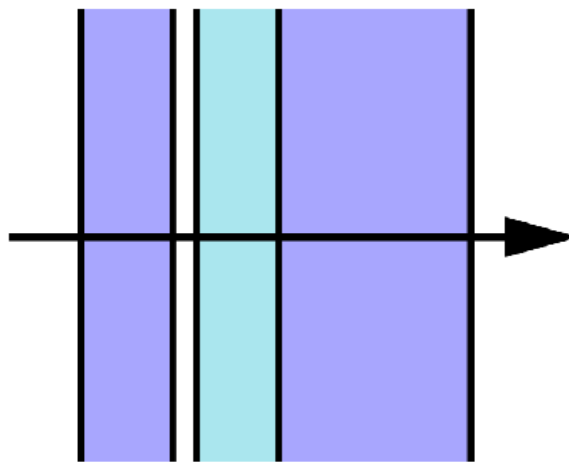
Where does air leak?

Anywhere it wants!

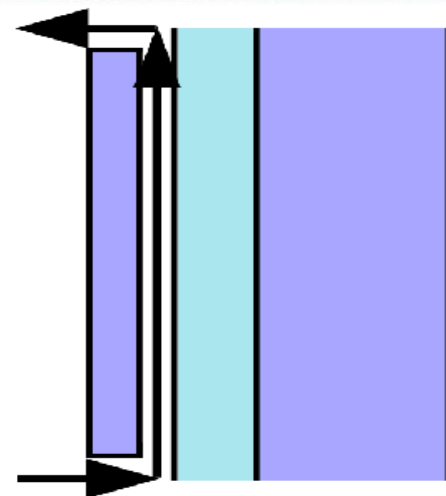
Air Barrier Technologies



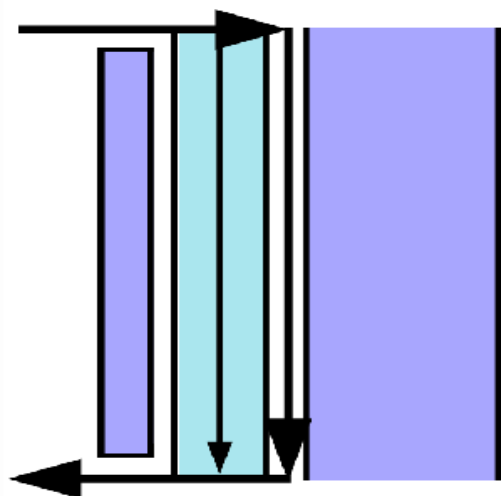
EXFILTRATION



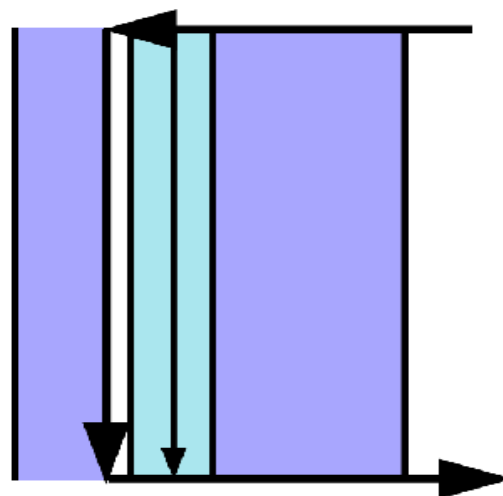
INFILTRATION



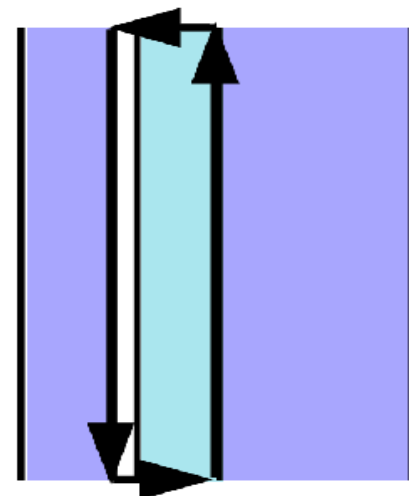
CAVITY VENTILATION



WIND WASHING



INDOOR AIR WASHING



AIR LOOPING

Types of air barriers



What does an air barrier do?

Makes a building operate properly!

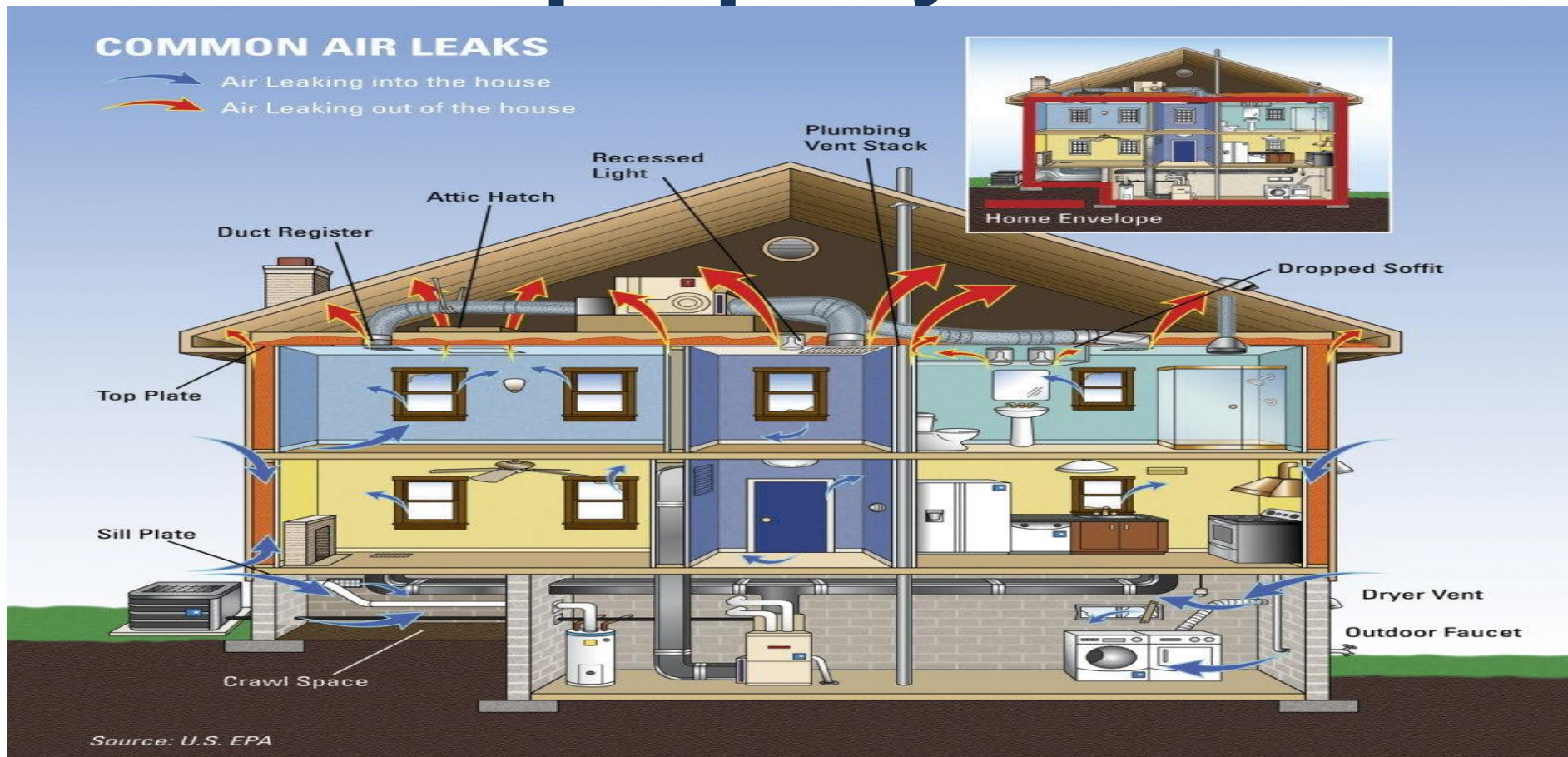
Makes a building operate properly!

- Reduces air infiltration and exfiltration – saves energy/money

Makes a building operate properly!

- **Reduces air infiltration and exfiltration – saves energy/money**
- **10% to 40% savings of the building envelope energy requirements**

Makes a building operate properly!



Makes a building operate properly!

- Can manage moisture in the envelope – liquid and vapor

Makes a building operate properly!

- Reduces sound transmission

Makes a building operate properly!

- **Increases occupant comfort**

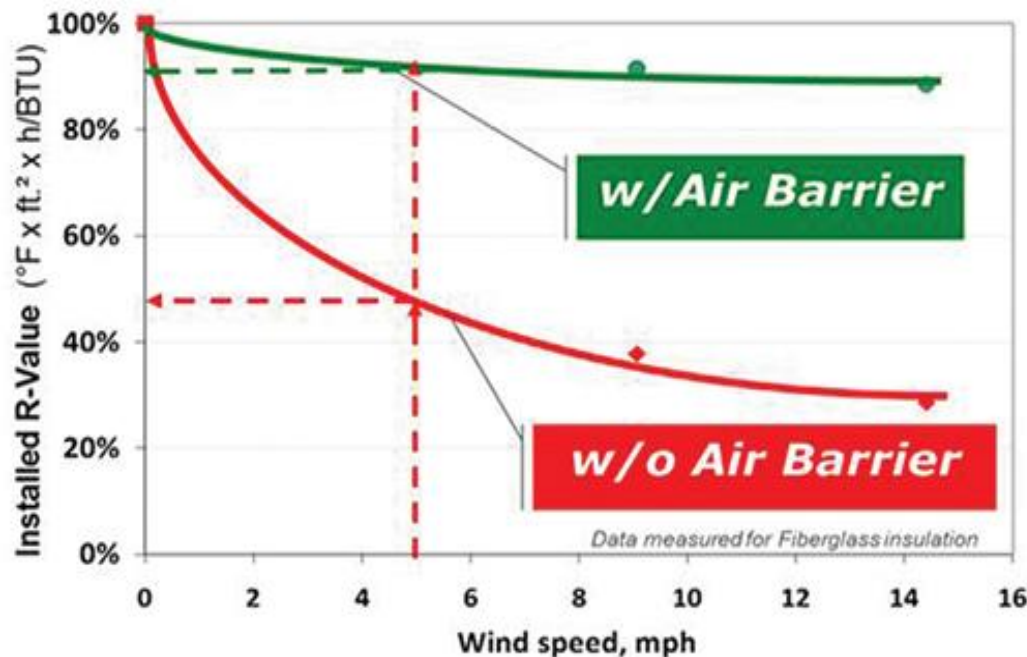
Makes a building operate properly!



Makes a building operate properly!

- **Makes fibrous insulation work as intended**

Makes a building operate properly!



Graph 1: Wind Washing Effect on Thermal Insulation Performance

Source: Impact of Airflow on the Thermal Performance of Various Residential Wall Systems utilizing a calibrated hot box, Thermal Envelopes VI/ Heat Transfer in Walls – Principles

Makes a building operate properly!

- Improves performance of windows

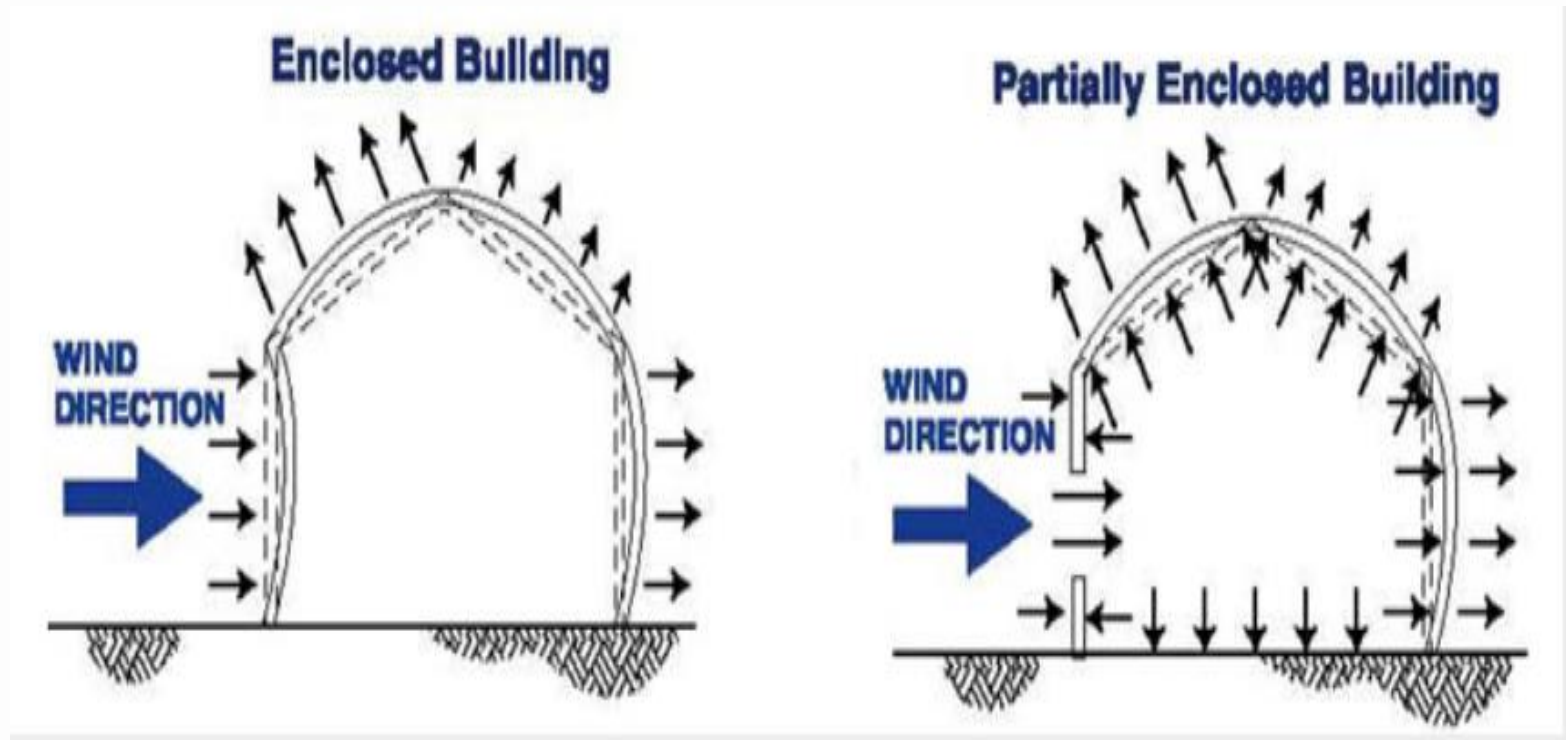
Makes a building operate properly!



Makes a building operate properly!

- Buildings can withstand severe weather events

Makes a building operate properly!



Makes a building operate properly!



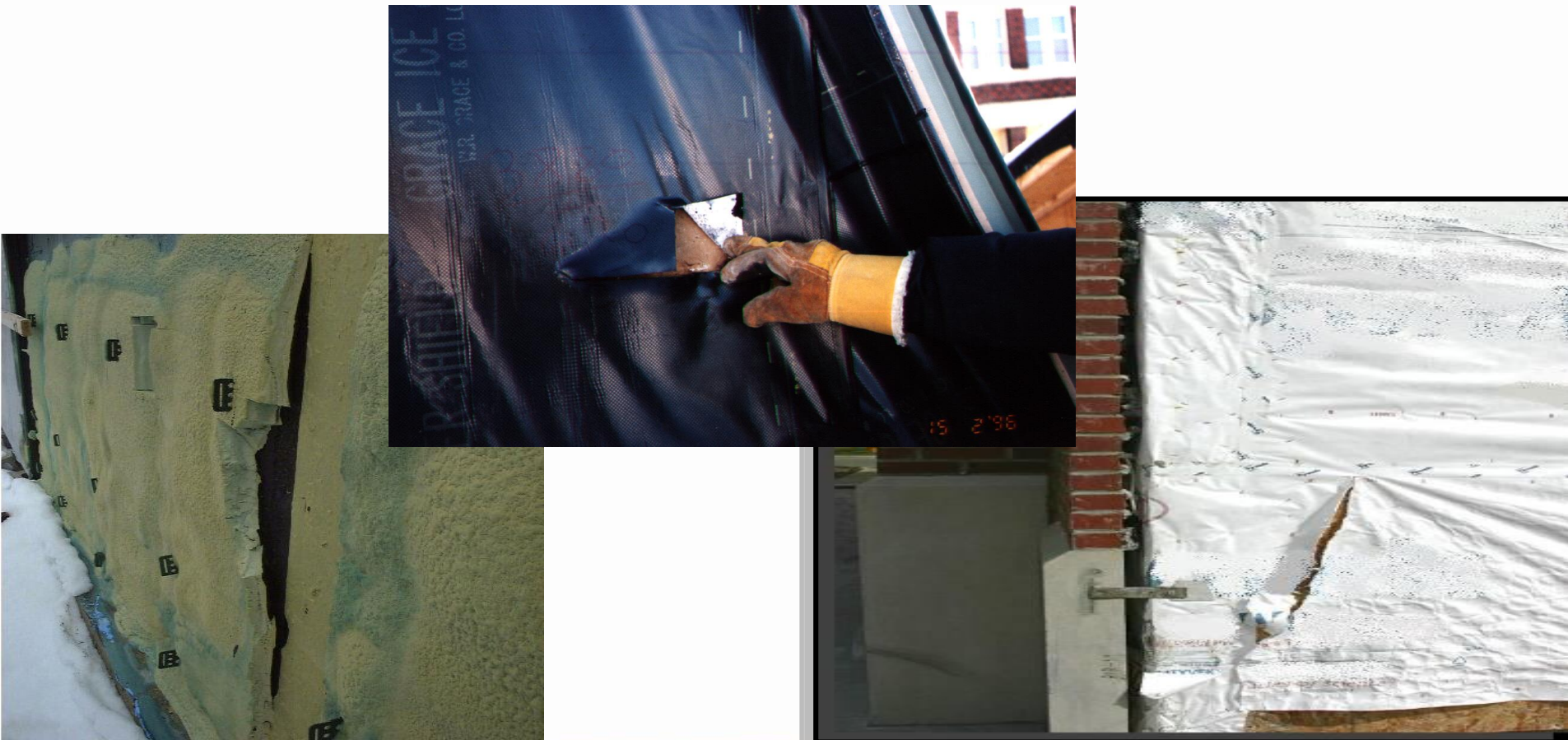
Makes a building operate properly!



Biggest Challenge to Air Barrier Performance



Biggest Challenge to Air Barrier Performance



***Air Barriers Are The Future to Achieve
Nearly Net Zero Buildings***

***Air Barriers Make your Building Work Today
and Tomorrow***

Thank you

Mr. Laverne Dalglish
ldalglish@airbarrier.org

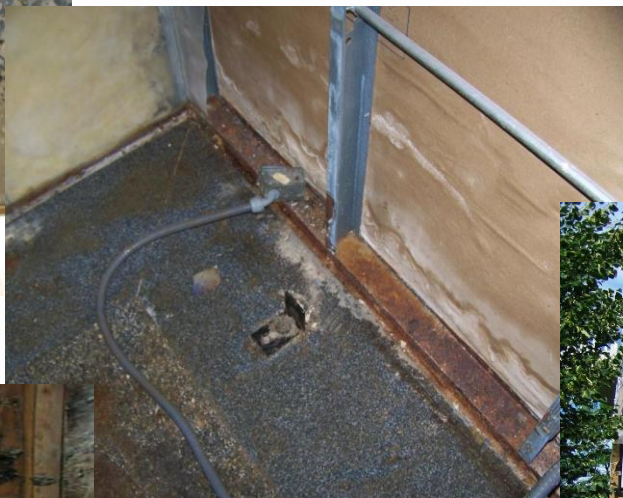
Makes a building operate properly!

- Can manage moisture in the envelope – liquid and vapor

Makes a building operate properly!



MOLD

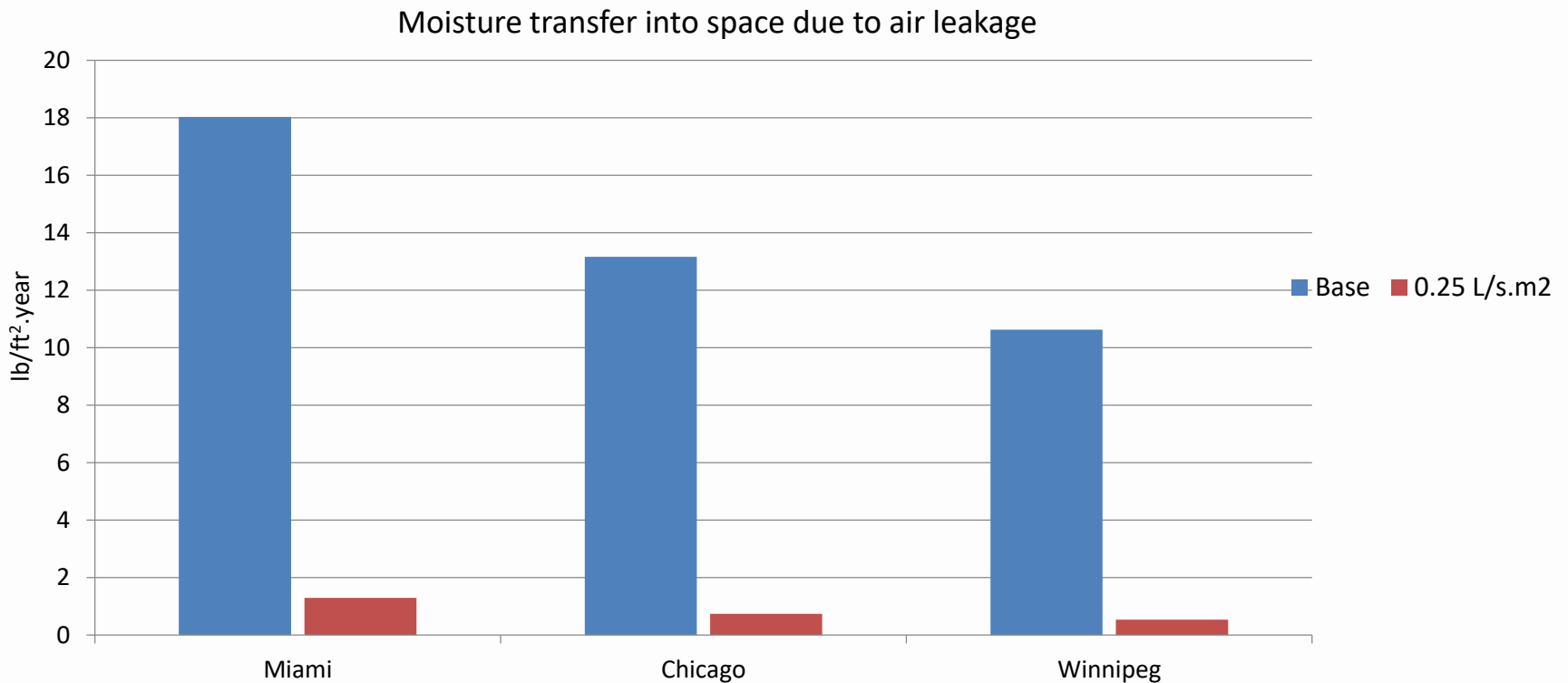


DAMAGE



WOOD ROT

Makes a building operate properly!



Makes a building operate properly!

- Reduces maintenance costs

Makes a building operate properly!



Makes a building operate properly!

- Reduces sound transmission

Makes a building operate properly!

- **Increases occupant comfort**

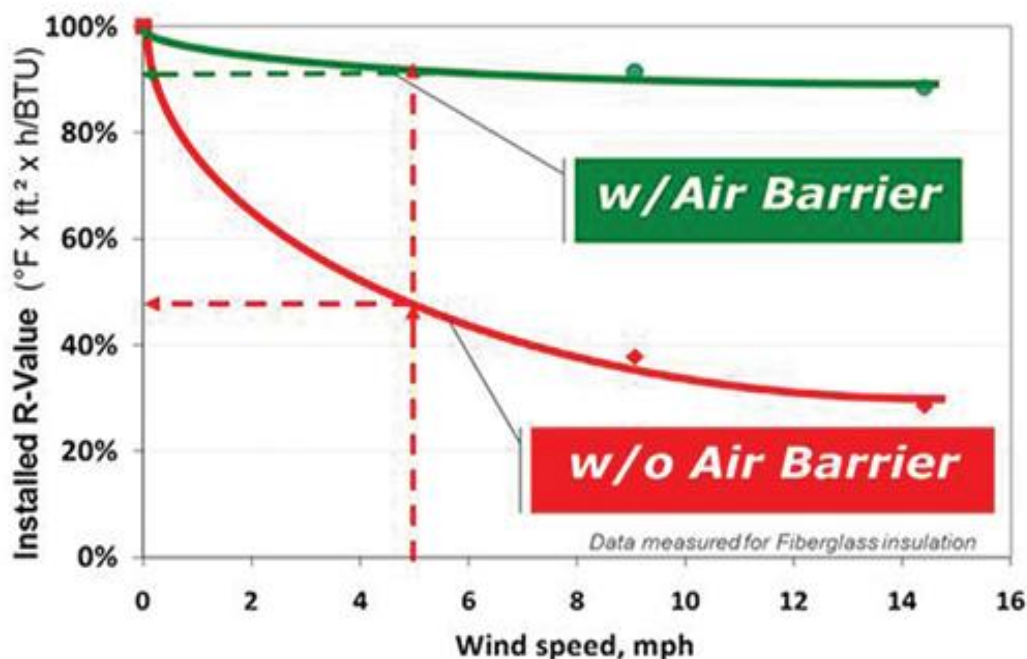
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- **Makes fibrous insulation work as intended**

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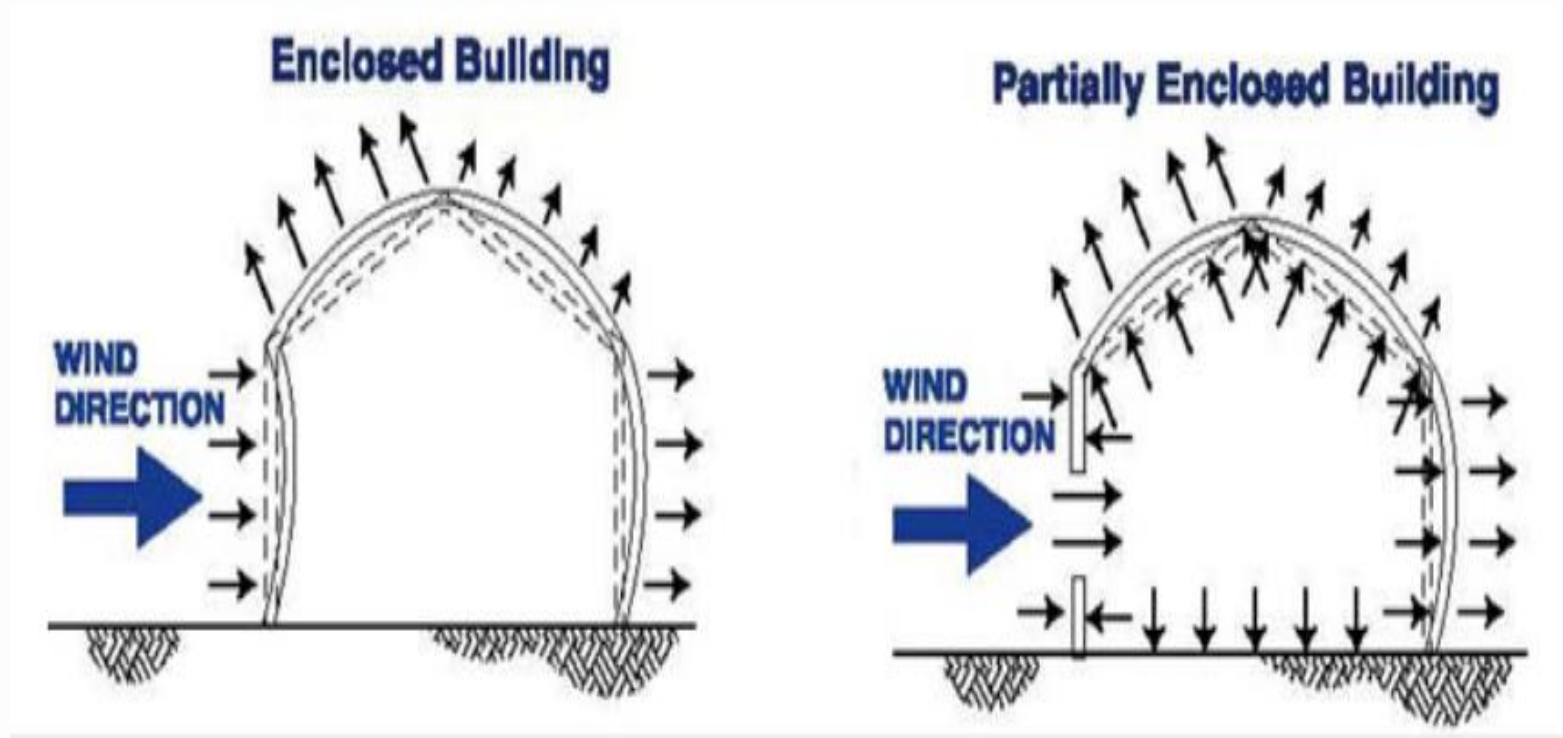
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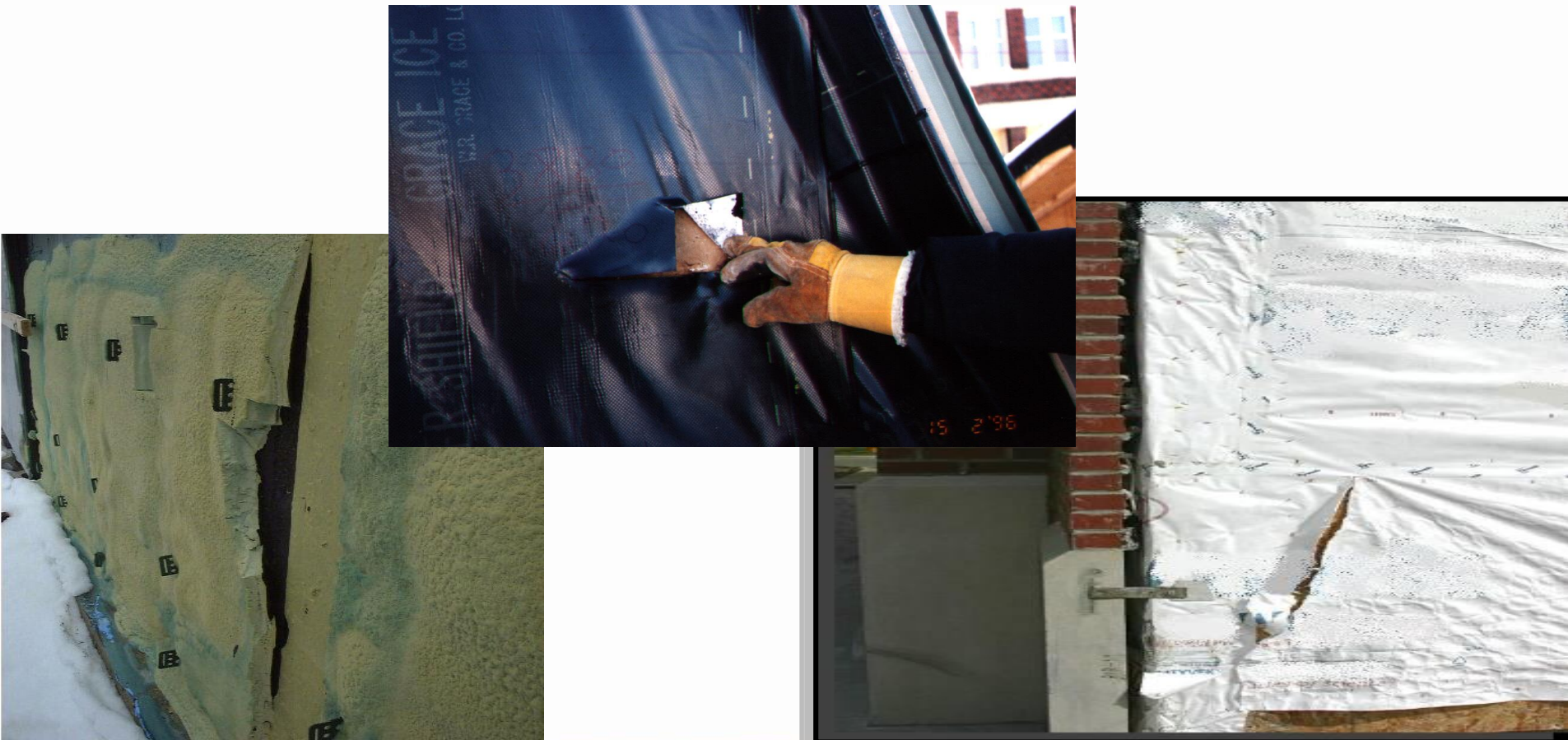
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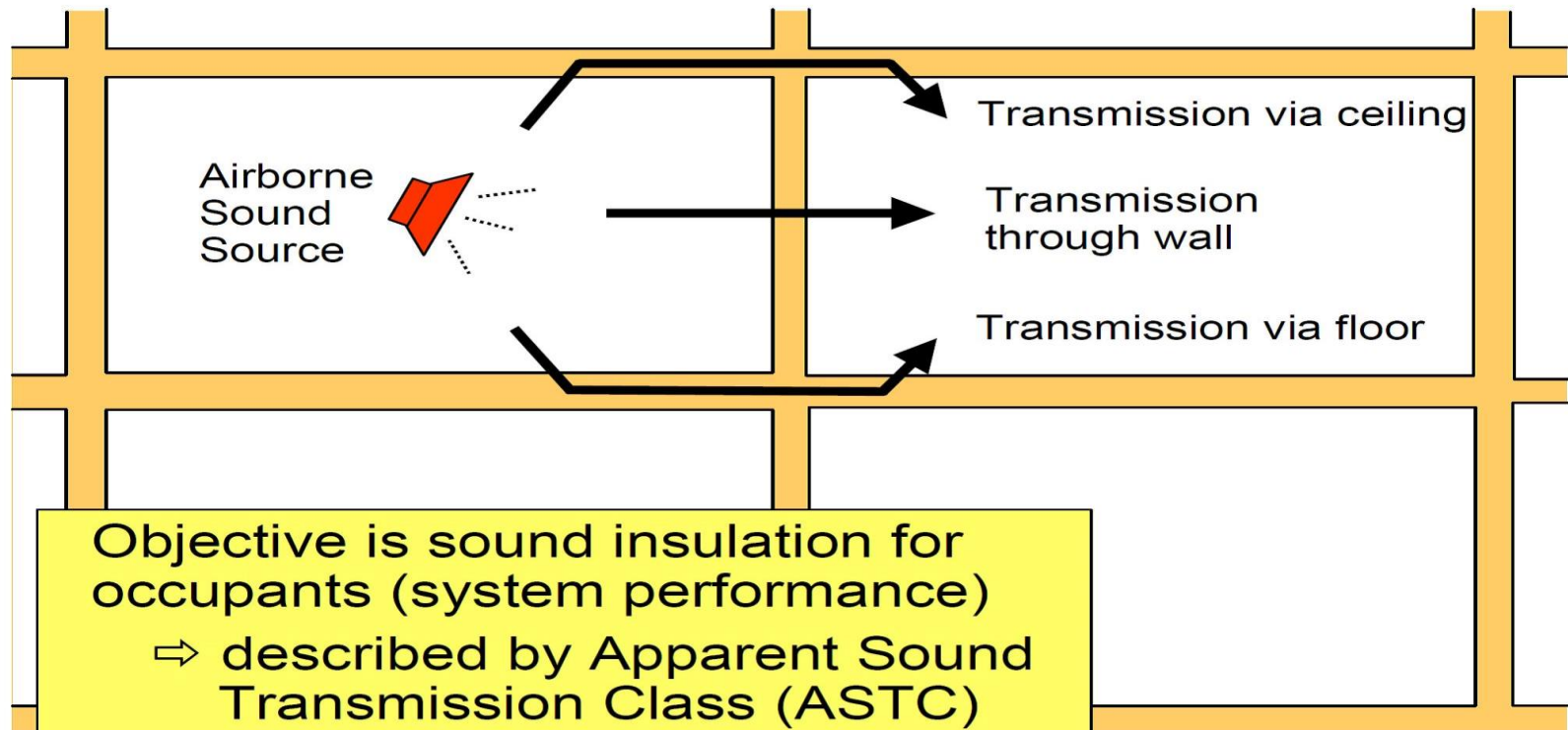
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Makes a building operate properly!

- Reduces sound transmission

Makes a building operate properly!

Transmission path in real building



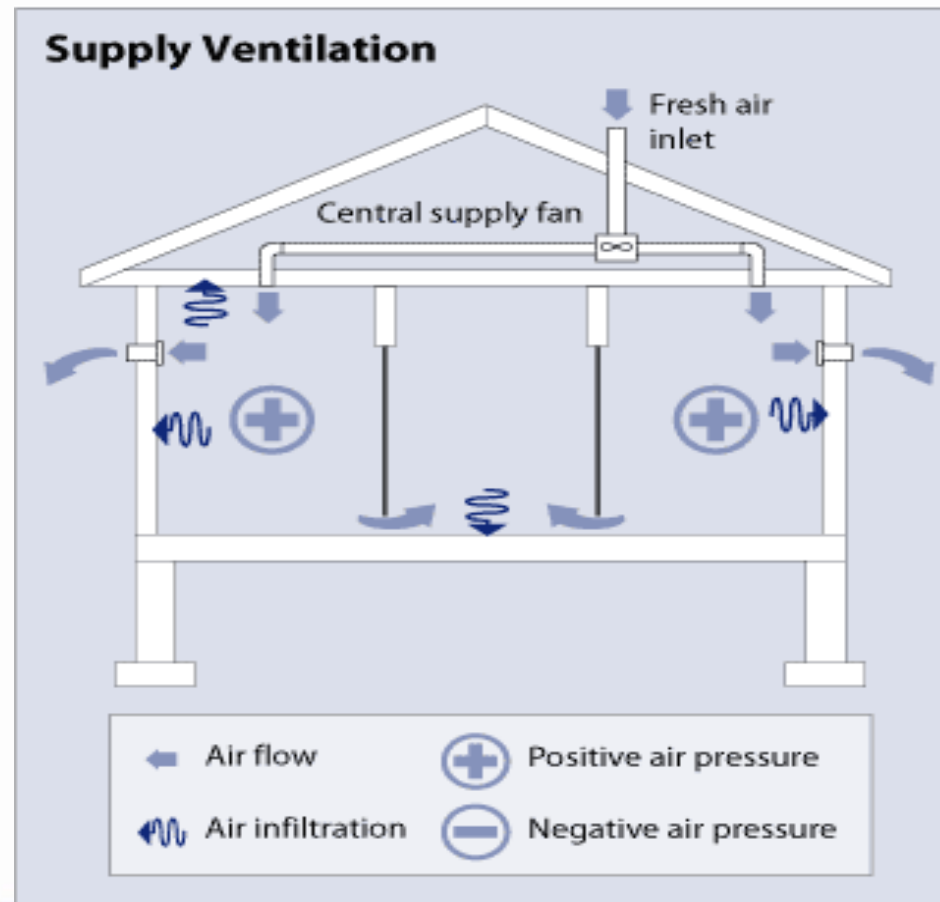
Makes a building operate properly!

- Makes the HVAC system work as intended

Makes a building operate properly!

- Makes the HVAC system work as intended
- Reducing energy use by the mechanical equipment

Makes a building operate properly!



Makes a building operate properly!

- **Increases occupant comfort**

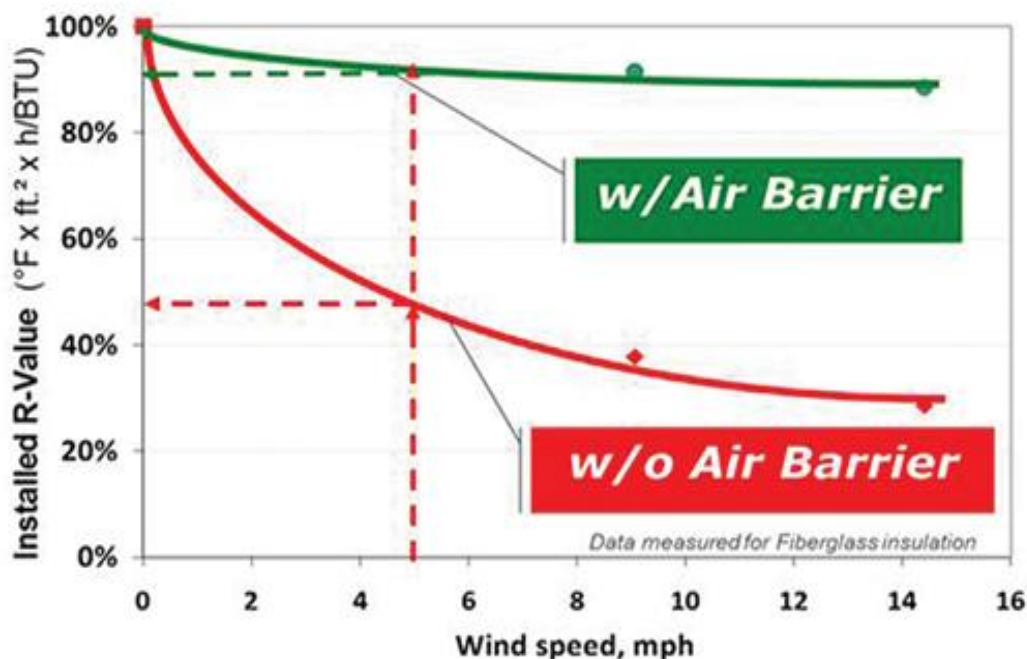
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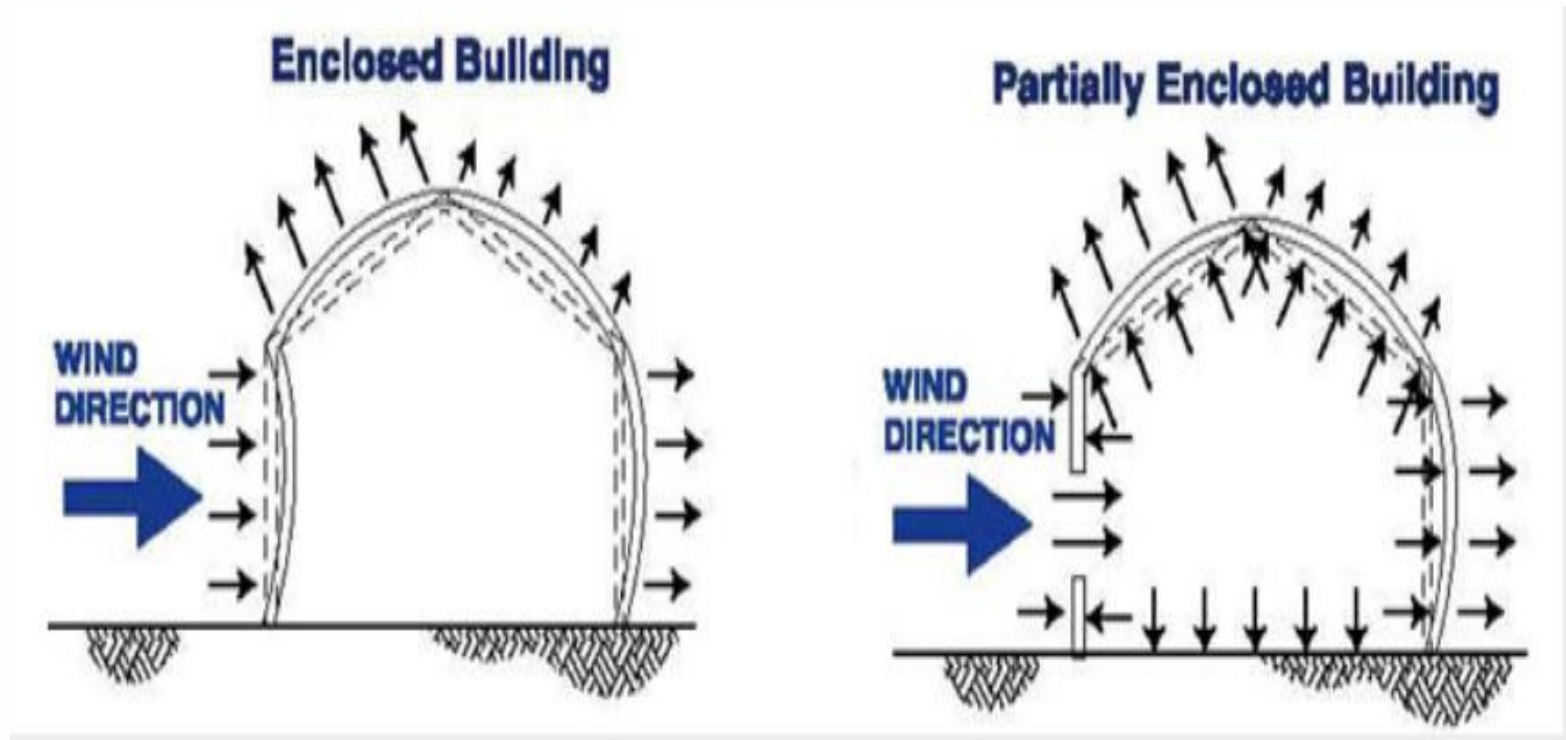
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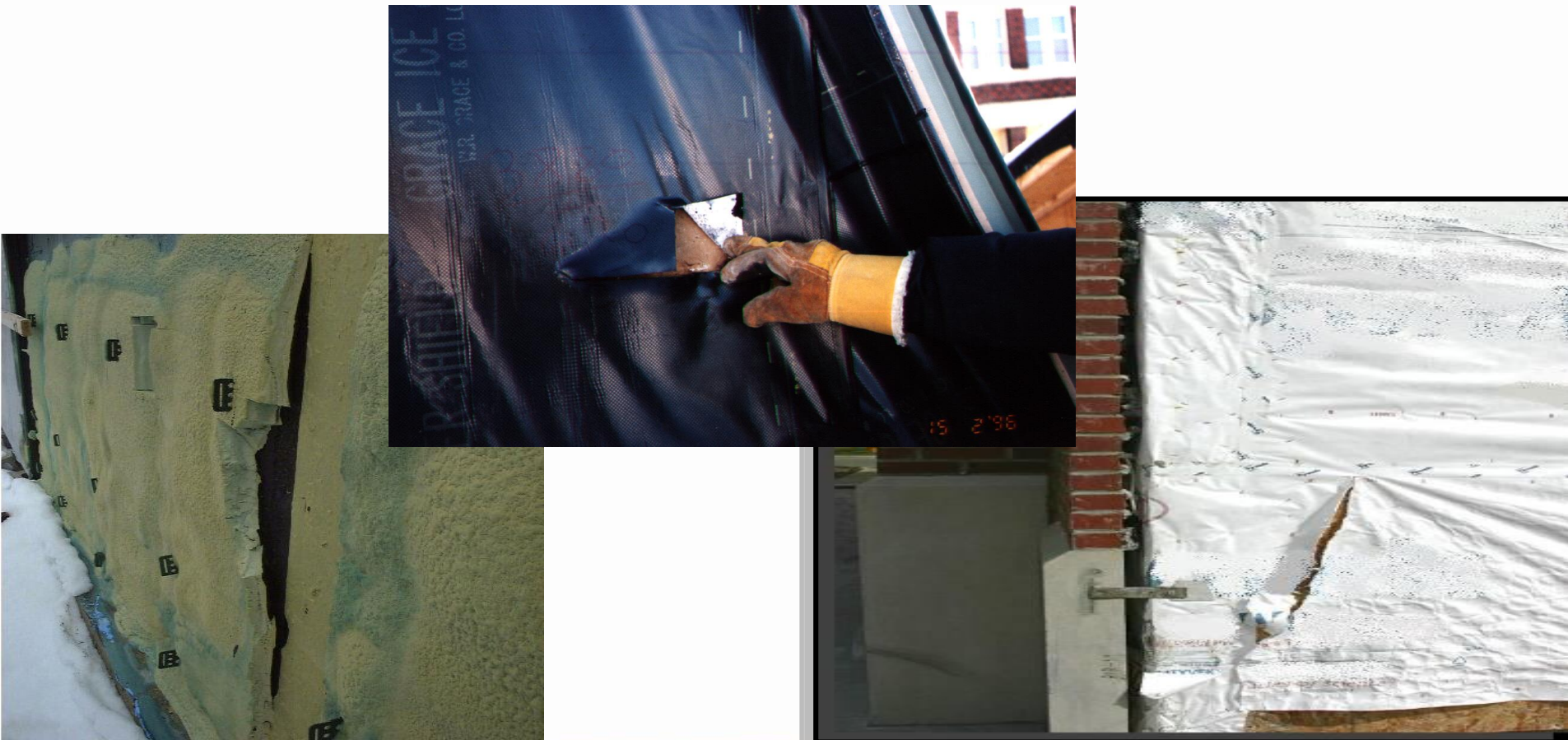
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Collaboration: the Envelope Tech Team

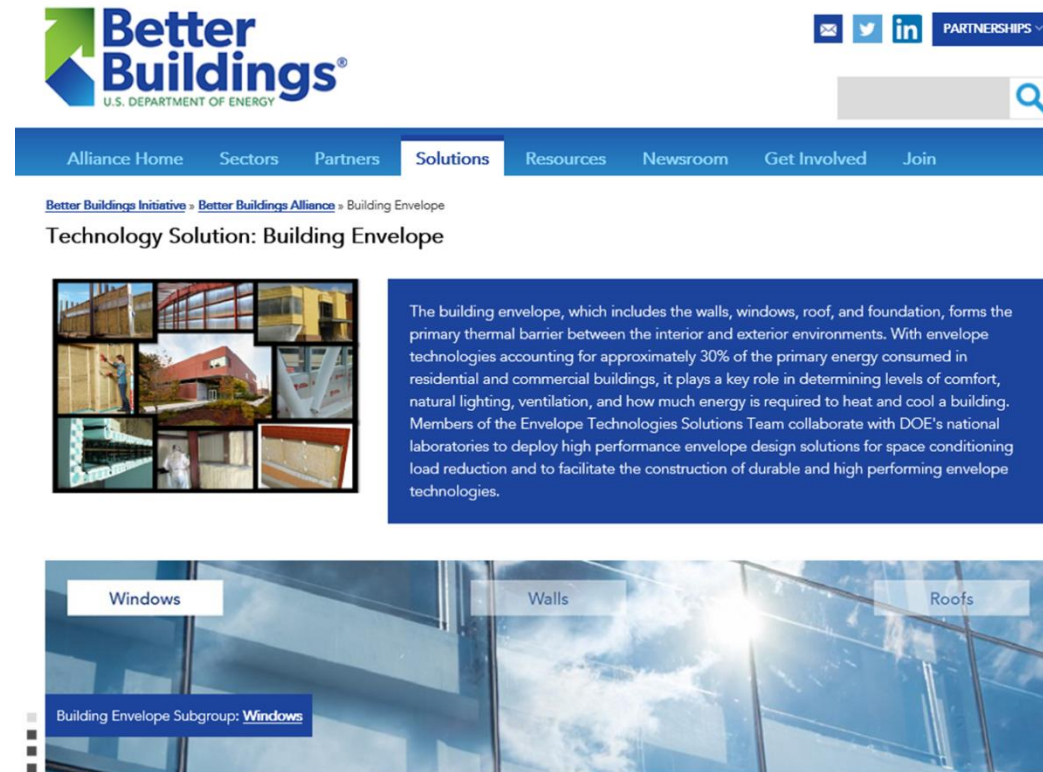
Engage and support Members in efforts to accelerate adoption of building envelope technologies



- **Build awareness** with guidance and information on envelope technology solutions
- Conduct envelope technology **verification studies**
- Offer **technical assistance** for envelope projects

Check out the Envelope Tech Team Web Resources

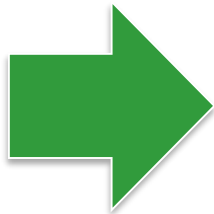
- Topic Areas
 - Windows
 - Walls
 - Roofs
- Resources
 - Case Studies
 - Calculators
 - Design Guides
 - Fact Sheets
 - Toolkits
 - ...and more...



<https://betterbuildingsinitiative.energy.gov/alliance/technology-solution/building-envelope>

Join the Envelope Tech Research Team!

Email: lapsamv@ornl.gov



Engage in R&D:

- Addressing airtightness requirements
- Investigating Building Enclosure Performance Metric

To join, email Melissa Lapsa: lapsamv@ornl.gov

Thank you!

Moderator

- **Melissa Voss Lapsa, ORNL, lapsamv@ornl.gov**

